CAREER & TECHNOLOGY STUDIES

FABRICATION STUDIES

GUIDE TO STANDARDS AND IMPLEMENTATION

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General Audience	
Parents	
Students	
Teachers	✓

Program/Level: Career and Technology Studies/Secondary

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This document supersedes all previous versions of the *Career & Technology Studies Guide to Standards and Implementation.*

This publication is a support document. The advice and direction offered is suggestive except where it duplicates the Program of Studies. The Program of Studies—a prescriptive description of the expectations of student learning, focusing on what students are expected to know and be able to do—is issued under the authority of the Minister of Education pursuant to section 25(1) of the *School Act*, Statutes of Alberta, 1988, Chapter S–3.1 as amended, and is required for implementation. **Within this document, the Program of Studies is shaded so that the reader may readily identify all prescriptive statements or segments.**

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Outside of Edmonton dial 310–0000 to be connected toll free.

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CAREER AND TECHNOLOGY STUDIES

A. PROGRAM RATIONALE AND PHILOSOPHY

Through Career and Technology Studies (CTS), secondary education in Alberta is responding to the many challenges of modern society, helping young people develop daily living skills and nurturing a flexible, well-qualified work force.

In Canada's information society, characterized by rapid change in the social and economic environment, students must be confident in their ability to respond to change and successfully meet the challenges they face in their own personal and work lives. In particular, they make decisions about what they will do when they finish high school. Many students will enter the work force, others will continue their education. All students face the challenges of growing independence and responsibility, and of entering post-secondary programs and/or the highly competitive workplace.

Secondary schools also face challenges. They must deliver, on a consistent basis, high quality, cost-effective programs that students, parents and the community find credible and relevant.

CTS helps schools and students meet these challenges. Schools can respond more efficiently and effectively to student and community needs and expectations by taking advantage of the opportunities in the CTS curriculum to design courses and access school, community and distance learning resources. Students can develop the confidence they need as they move into adult roles by assuming increased responsibility for their learning; cultivating their individual talents, interests and abilities; and by defining and acting on their goals.

As an important component of education in Alberta secondary schools, CTS promotes student achievement by setting clear expectations and recognizing student success. Students in CTS develop competencies—the knowledge, skills and attitudes they are expected to demonstrate, that is, what they know and what they are able to do.

Acquired competencies can be applied now and in the future as students make a smooth transition into adult roles in the family, community, workplace and/or further education. To facilitate this transition, clearly stated expectations and standards have been defined in cooperation with teachers, business and industry representatives and post-secondary educators.

CTS offers all students important learning opportunities. Regardless of the particular area of study chosen, *students* in CTS *will*:

- develop skills that can be applied in their daily lives, now and in the future
- refine career-planning skills
- develop technology-related skills
- enhance employability skills
- apply and reinforce learnings developed in other subject areas.

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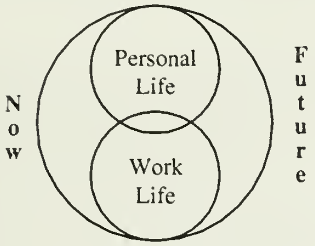
In CTS, students build skills they can apply in their everyday lives. For example, in the CTS program, particularly at the introductory levels, students have the opportunity to improve their ability to make sound consumer decisions and to appreciate environmental and safety precautions.

CAREERS



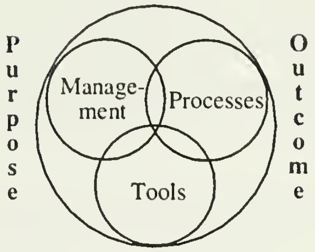
A career encompasses more than activities just related to a person's job or occupation; it involves one's personal life in both local and global contexts; e.g., as a family member, a friend, a community volunteer, a citizen of the world.

The integration of careers throughout the CTS program helps students to make effective career decisions and to target their efforts. CTS students will have the opportunity to expand their knowledge about careers, occupations and job opportunities, as well as the education and/or training requirements involved. Also, students come to recognize the need for lifelong learning.

Students in CTS have the opportunity to use and apply technology and systems effectively and efficiently. This involves:

- a decision regarding which processes and procedures best suit the task at hand
- the appropriate selection and skilled use of the tools and/or resources available
- an assessment of and management of the impact the use of the technology may have on themselves, on others and on the environment.

TECHNOLOGY



Integrated throughout CTS are employability skills, those basic competencies that help students develop their personal management and social skills. Personal management skills are improved as students take increased responsibility for their learning, design innovative solutions to problems and challenges, and manage resources effectively and efficiently. Social skills improve through learning experiences that require students to work effectively with others, demonstrate teamwork and leadership, and maintain high standards in safety and accountability.

As well as honing employability skills, CTS reinforces and enhances learnings developed in core and other optional courses. The curriculum emphasizes, as appropriate, the effective application of communication and numeracy skills.

In addition to the common outcomes described above, students focusing on a particular area of study will develop career-specific competencies that support entry into the workplace and/or related post-secondary programs. Career-specific competencies can involve understanding and applying appropriate terminology, processes and technologies related to a specific career, occupation or job.

PROGRAM OUTCOMES

The program outcomes describe the basic competencies integrated throughout the CTS program.

Within an applied context relevant to personal goals, aptitudes and abilities; *the student* in CTS *will*:

- demonstrate the basic knowledge, skills and attitudes necessary for achievement and fulfillment in personal life
- develop an action plan that relates personal interests, abilities and aptitudes to career opportunities and requirements
- use technology effectively to link and apply appropriate tools, management and processes to produce a desired outcome
- develop basic competencies (employability skills), by:
    - selecting relevant, goal-related activities, ranking them in order of importance, allocating necessary time, and preparing and following schedules (managing learning)
    - linking theory and practice, using resources, tools, technology and processes responsibly and efficiently (managing resources)
    - applying effective and innovative decision-making and problem-solving strategies in the design, production, marketing and consumption of goods and services (problem solving and innovation)
    - demonstrating appropriate written and verbal skills, such as composition, summarization and presentation (communicating effectively)
    - participating as a team member by working cooperatively with others and contributing to the group with ideas, suggestions and effort (working with others)
    - maintaining high standards of ethics, diligence, attendance and punctuality, following safe procedures consistently, and recognizing and eliminating potential hazards (demonstrating responsibility).

PROGRAM ORGANIZATION

CURRICULUM STRUCTURE

Career and Technology Studies is organized into **strands** and **courses**.

Strands in CTS define competencies that help students:

- build daily living skills
- investigate career options
- use technology (managing, processes, tools) effectively and efficiently
- prepare for entry into the workplace and/or related post-secondary programs.

In general, strands relate to selected industry sectors offering positive occupational opportunities for students. Some occupational opportunities require further education after high school, and some allow direct entry into the workplace. Industry sectors encompass goods-producing industries, such as agriculture, manufacturing and construction; and service-producing industries, such as business, health, finance and insurance.

Courses are the building blocks for each strand. They define what a student is expected to know and be able to do (exit-level *competencies*). Courses also specify prerequisites. Recommendations for course parameters, such as instructional qualifications, facilities and equipment can be found in the guides to implementation.

The competencies a student must demonstrate to achieve success in a course are defined through *general outcomes*. Senior high school students who can demonstrate the general outcomes defined for a CTS course; i.e., who have the designated competencies, will qualify for 1 credit toward their high school diploma.

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Specific outcomes provide a more detailed framework for instruction. Within the context of the general outcomes, the specific outcomes further define the knowledge, skills and attitudes the student should acquire.

The following chart shows the 22 strands that comprise the CTS program and the number of 1-credit courses available in each strand.

Strand	No. of Courses
1. Agriculture	33
2. Career Transitions	31
3. Communication Technology	33
4. Community Health	31
5. Construction Technologies	46
6. Cosmetology Studies	58
7. Design Studies	31
8. Electro-Technologies	37
9. Energy and Mines	26
10. Enterprise and Innovation	8
11. Fabrication Studies	41
12. Fashion Studies	29
13. Financial Management	14
14. Foods	37
15. Forestry	21
16. Information Processing	48
17. Legal Studies	13
18. Logistics	12
19. Management and Marketing	20
20. Mechanics	54
21. Tourism Studies	24
22. Wildlife	17

LEVELS OF ACHIEVEMENT

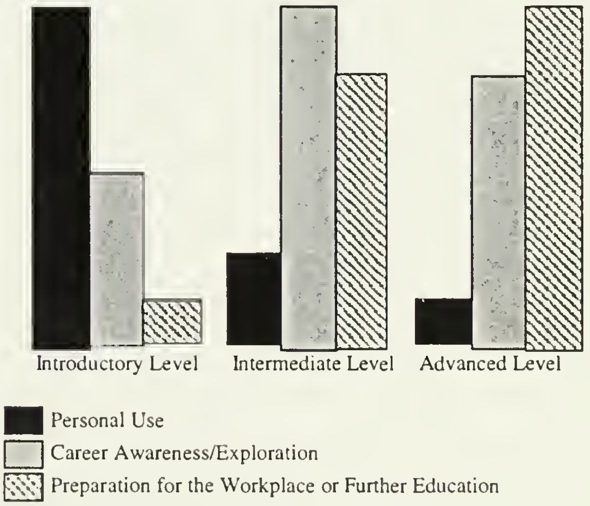
Courses are organized into three levels of achievement: **introductory, intermediate** and **advanced**. As students progress through the levels, they will be expected to meet higher standards and demonstrate an increased degree of competence, in both the program outcomes and the general outcomes defined for individual courses.

Introductory level courses help students build daily living skills and form the basis for further learning. Introductory courses are for students who have no previous experience in the strand.

Intermediate level courses build on the competencies developed at the introductory level. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Advanced level courses refine expertise and help prepare students for entry into the workplace or a related post-secondary program.

The graph below illustrates the relative emphasis on the aspects of career planning at each of the levels.



CURRICULUM AND ASSESSMENT STANDARDS

Curriculum standards in CTS define what students must know and be able to do. Curriculum standards are expressed through the program outcomes for CTS, and through general and specific outcomes defined for individual courses within each strand.

Assessment standards define how student performance is to be judged. In CTS, each assessment standard defines the conditions and criteria to be used for assessing the competencies associated with each general outcome. To receive credit for a course, students must demonstrate competency at the level specified by the conditions and criteria defined for each general outcome.

Students throughout the province receive a fair and reliable assessment as they use the standards to guide their efforts, thus ensuring they participate more effectively and successfully in the learning and assessment process. Standards at advanced levels are, as much as possible, linked to workplace and post-secondary entry-level requirements.

TYPES OF COMPETENCIES

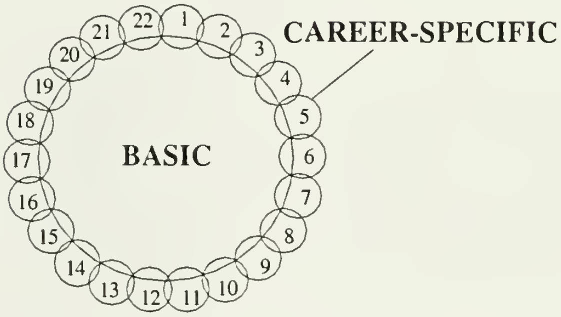
Two types of competencies are defined within the CTS program: basic and career-specific.

Basic competencies are generic to any career area and are developed within each course. Basic competencies include:

- personal management; e.g., managing learning, being innovative, ethics, managing resources
- social; e.g., communication, teamwork, leadership and service, demonstrating responsibility (safety and accountability).

Career-specific competencies relate to a particular strand. These competencies build daily living skills at the introductory levels and support the smooth transition to the workplace and/or post-secondary programs at the intermediate and advanced levels.

The model below shows the relationship of the two types of competencies within the 22 strands of the CTS program.



BASIC COMPETENCIES REFERENCE GUIDE

The chart below outlines basic competencies that students endeavour to develop and enhance in each of the CTS strands and courses. Students' basic competencies should be assessed through observations involving the student, teacher(s), peers and others as they complete the requirements for each course. In general, there is a progression of task complexity and student initiative as outlined in the Developmental Framework★. **As students progress through Stages 1, 2, 3 and 4 of this reference guide, they build on the competencies gained in earlier stages.** Students leaving high school should set themselves a goal of being able to demonstrate Stage 3 performance.

Suggested strategies for classroom use include:

- having students rate themselves and each other
- using in reflective conversation between teacher and student
- highlighting areas of strength
- tracking growth in various CTS strands
- highlighting areas upon which to focus
- maintaining a student portfolio.

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Managing Learning			
☐ comes to class prepared for learning	☐ →	☐ →	☐ →
☐ follows basic instructions, as directed	☐ follows instructions, with limited direction	☐ follows detailed instructions on an independent basis	☐ →
	☐ sets goals and establishes steps to achieve them, with direction	☐ sets clear goals and establishes steps to achieve them	☐ demonstrates self-direction in learning, goal setting and goal achievement
☐ acquires specialized knowledge, skills and attitudes	☐ applies specialized knowledge, skills and attitudes in practical situations	☐ transfers and applies specialized knowledge, skills and attitudes in a variety of situations	☐ transfers and applies learning in new situations; demonstrates commitment to lifelong learning
☐ identifies criteria for evaluating choices and making decisions	☐ identifies and applies a range of effective strategies for solving problems and making decisions	☐ uses a range of critical thinking skills to evaluate situations, solve problems and make decisions	☐ thinks critically and acts logically to evaluate situations, solve problems and make decisions
☐ uses a variety of learning strategies	☐ explores and uses a variety of learning strategies, with limited direction	☐ selects and uses effective learning strategies	☐ →
		☐ cooperates with others in the effective use of learning strategies	☐ provides leadership in the effective use of learning strategies
Managing Resources			
☐ adheres to established timelines; uses time/schedules/planners effectively	☐ creates and adheres to timelines, with limited direction; uses time/schedules/planners effectively	☐ creates and adheres to detailed timelines on an independent basis; prioritizes task; uses time/schedules/planners effectively	☐ creates and adheres to detailed timelines; uses time/schedules/planners effectively; prioritizes tasks on a consistent basis
☐ uses information (material and human resources), as directed	☐ accesses and uses a range of relevant information (material and human resources), with limited direction	☐ accesses a range of information (material and human resources), and recognizes when additional resources are required	☐ uses a wide range of information (material and human resources) in order to support and enhance the basic requirement
☐ uses technology (facilities, equipment, supplies), as directed, to perform a task or provide a service	☐ uses technology (facilities, equipment, supplies), as appropriate, to perform a task or provide a service, with minimal assistance and supervision	☐ selects and uses appropriate technology (facilities, equipment, supplies) to perform a task or provide a service on an independent basis	☐ recognizes the monetary and intrinsic value of managing technology (facilities, equipment, supplies)
☐ maintains, stores and/or disposes of equipment and materials, as directed	☐ maintains, stores and/or disposes of equipment and materials, with limited assistance	☐ maintains, stores and/or disposes of equipment and materials on an independent basis	☐ demonstrates effective techniques for managing facilities, equipment and supplies
Problem Solving and Innovation			
☐ participates in problem solving as a process ☐ learns a range of problem-solving skills and approaches	☐ identifies the problem and selects an appropriate problem-solving approach, responding appropriately to specified goals and constraints	☐ thinks critically and acts logically in the context of problem solving	☐ identifies and resolves problems efficiently and effectively
☐ practices problem-solving skills by responding appropriately to a clearly defined problem, specified goals and constraints, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ applies problem-solving skills to a directed or a self-directed activity, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ transfers problem-solving skills to real-life situations, by generating new possibilities ☐ prepares implementation plans ☐ recognizes risks	☐ identifies and suggests new ideas to get the job done creatively, by: – combining ideas or information in new ways – making connections among seemingly unrelated ideas – seeking out opportunities in an active manner

Stage 1— *The student:*	**Stage 2—** *The student:*	**Stage 3—** *The student:*	**Stage 4—** *The student:*
Communicating Effectively			
☐ uses communication skills; e.g., reading, writing, illustrating, speaking	☐ communicates thoughts, feelings and ideas to justify or challenge a position, using written, oral and/or visual means	☐ prepares and effectively presents accurate, concise, written, visual and/or oral reports providing reasoned arguments	☐ negotiates effectively, by working toward an agreement that may involve exchanging specific resources or resolving divergent interests
☐ uses language in appropriate context	☐ uses technical language appropriately	☐ encourages, persuades, convinces or otherwise motivates individuals	☐ negotiates and works toward a consensus
☐ listens to understand and learn	☐ listens and responds to understand and learn	☐ listens and responds to understand, learn and teach	☐ listens and responds to understand, learn, teach and evaluate
☐ demonstrates positive interpersonal skills in selected contexts	☐ demonstrates positive interpersonal skills in many contexts	☐ demonstrates positive interpersonal skills in most contexts	☐ promotes positive interpersonal skills among others
Working with Others			
☐ fulfills responsibility in a group project	☐ ——▶——▶	☐ seeks a team approach, as appropriate, based on group needs and benefits; e.g., idea potential, variety of strengths, sharing of workload	☐ leads, where appropriate, mobilizing the group for high performance
☐ works collaboratively in structured situations with peer members	☐ cooperates to achieve group results	☐ works in a team or group: – encourages and supports team members – helps others in a positive manner – provides leadership/followership as required – negotiates and works toward consensus as required	☐ understands and works within the context of the group
☐ acknowledges the opinions and contributions of others in the group	☐ maintains a balance between speaking, listening and responding in group discussions ☐ respects the feelings and views of others		☐ prepares, validates and implements plans that reveal new possibilities
Demonstrating Responsibility			
Attendance			
☐ demonstrates responsibility in attendance, punctuality and task completion	☐ ——▶——▶	☐ ——▶——▶	☐ ——▶——▶
Safety			
☐ follows personal and environmental health and safety procedures	☐ recognizes and follows personal and environmental health and safety procedures	☐ establishes and follows personal and environmental health and safety procedures	☐ transfers and applies personal and environmental health and safety procedures to a variety of environments and situations
☐ identifies immediate hazards and their impact on self, others and the environment	☐ identifies immediate and potential hazards and their impact on self, others and the environment	☐ ——▶——▶	☐ ——▶——▶
☐ follows appropriate/emergency response procedures	☐ ——▶——▶	☐ ——▶——▶	☐ ——▶——▶ ☐ demonstrates accountability for actions taken to address immediate and potential hazards
Ethics			
☐ makes personal judgements about whether or not certain behaviours/actions are right or wrong	☐ assesses how personal judgements affect other peer members and/or family; e.g., home and school	☐ assesses the implications of personal/group actions within the broader community; e.g., workplace	☐ analyzes the implications of personal/group actions within the global context ☐ states and defends a personal code of ethics as required

★**Developmental Framework**			
• *Simple task* • *Structured environment* • *Directed learning*	• *Task with limited variables* • *Less structured environment* • *Limited direction*	• *Task with multiple variables* • *Flexible environment* • *Self-directed learning, seeking assistance as required*	• *Complex task* • *Open environment* • *Self-directed/self-motivated*

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FABRICATION STUDIES

B. STRAND RATIONALE AND PHILOSOPHY

Metal products and structures have shaped world history. For thousands of years, metals have been shaped, joined and cast into items that have utilitarian and artistic value. Today, the search continues to develop new metals, processes and products for the 21st century.

The fabricated materials sector of the Canadian economy is characterized by a large number of small entrepreneurial businesses that supply the construction and manufacturing industries' intermediate or finished product requirements. This sector is a medium technology industry that depends principally on metals and related materials.

To compete in North American and global markets, the fabricated materials sector is investing in leading-edge technology and is hiring highly trained and talented people to manage and operate this technology effectively and efficiently.

The Fabrication Studies strand has been developed within Career and Technology Studies to help meet this training need. Students selecting modules from the Fabrication Studies strand have the opportunity to investigate and develop important knowledge, skills and attitudes related to the properties of materials and the design and fabrication of products.

In this strand, students are provided with a broad base of relevant theory and practice that builds daily living and career-specific skills. Successful completion of advanced level modules gives students the skills and experience required for entry-level employment or for post-secondary education.

Within the philosophy of Career and Technology Studies, *students* in Fabrication Studies *will*:

- develop safe work and environmental practices
- develop self- and resource-management skills
- link the knowledge, skills and attitudes developed in other courses in meaningful and practical ways to the study of fabrication processes
- demonstrate flexibility, cooperative work behaviours, and effective communication and leadership skills
- link theory and practice using available resources, tools and materials responsibly and efficiently
- expand personal knowledge and appreciation of career options and training opportunities.

STRAND ORGANIZATION

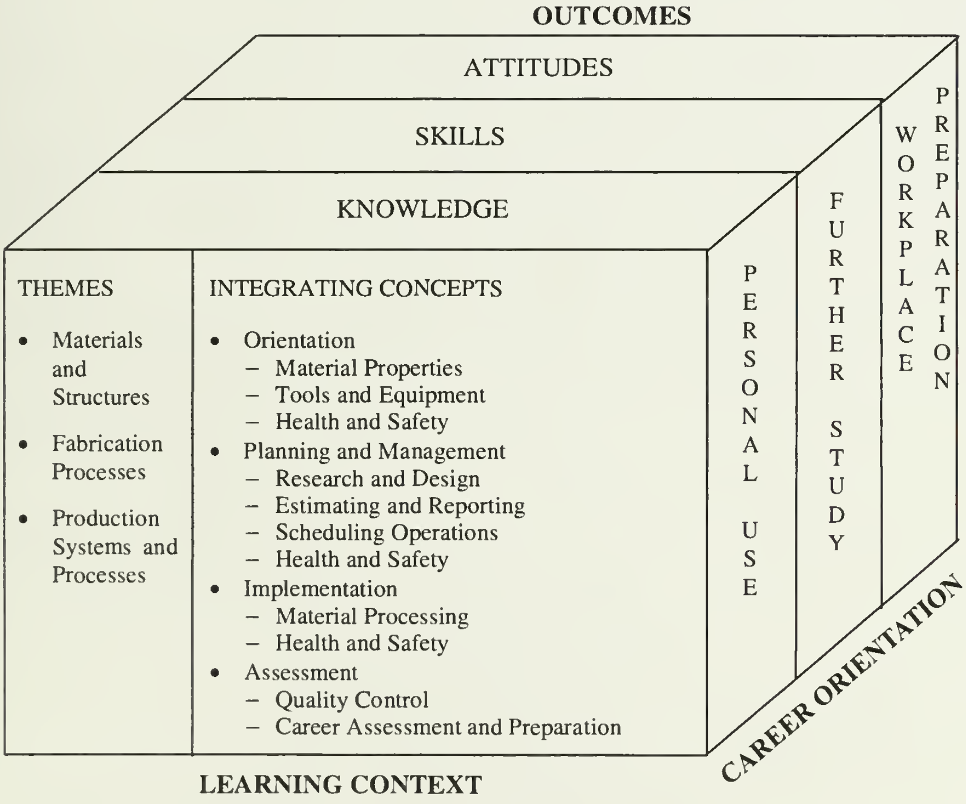
THEMES

The Fabrication Studies development model, shown below, has been developed around three themes that are central to the transformation of metals and like materials into useful artifacts and structures. These themes are:

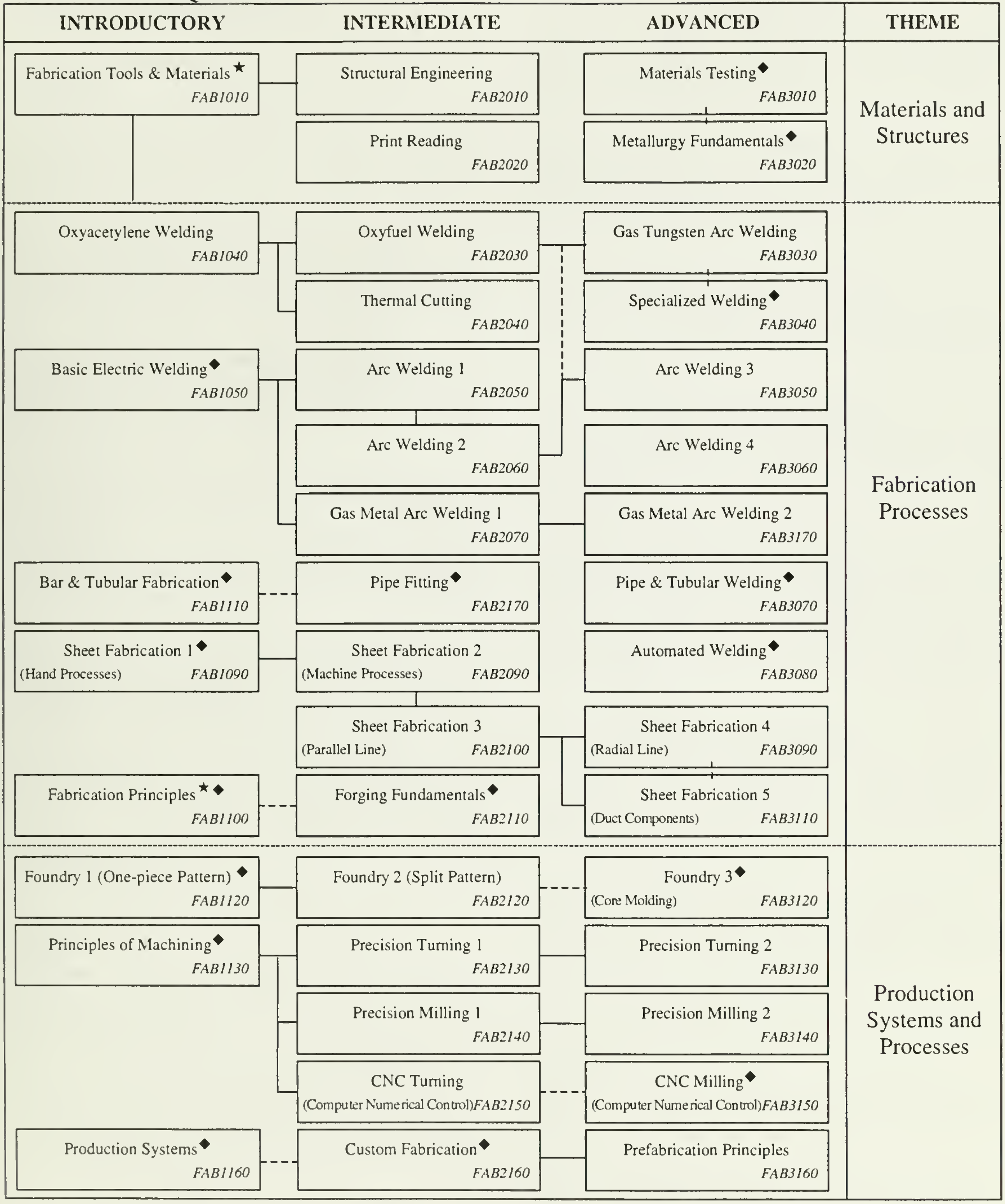
- Materials and Structures
- Fabrication Processes (cutting, bending, joining, finishing)
- Production Systems and Processes (casting, machining).

INTEGRATING CONCEPTS

Integrating concepts, shown on the face of the model, provide a basic framework for the study of each module. The context in which the learning takes place varies according to the available resources and the experience, background and intent of the learner. As the student is engaged in the learning activities in the school or in the community, specific outcomes are anticipated. These outcomes take the form of basic and career-specific knowledge, skills and attitudes that have been constructed by the learner.



SCOPE AND SEQUENCE FABRICATION STUDIES



INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Fabrication Tools & Materials ★ *FAB1010*	Structural Engineering *FAB2010*	Materials Testing ◆ *FAB3010*	Materials and Structures
	Print Reading *FAB2020*	Metallurgy Fundamentals ◆ *FAB3020*	
Oxyacetylene Welding *FAB1040*	Oxyfuel Welding *FAB2030*	Gas Tungsten Arc Welding *FAB3030*	Fabrication Processes
	Thermal Cutting *FAB2040*	Specialized Welding ◆ *FAB3040*	
Basic Electric Welding ◆ *FAB1050*	Arc Welding 1 *FAB2050*	Arc Welding 3 *FAB3050*	
	Arc Welding 2 *FAB2060*	Arc Welding 4 *FAB3060*	
	Gas Metal Arc Welding 1 *FAB2070*	Gas Metal Arc Welding 2 *FAB3170*	
Bar & Tubular Fabrication ◆ *FAB1110*	Pipe Fitting ◆ *FAB2170*	Pipe & Tubular Welding ◆ *FAB3070*	
Sheet Fabrication 1 ◆ (Hand Processes) *FAB1090*	Sheet Fabrication 2 (Machine Processes) *FAB2090*	Automated Welding ◆ *FAB3080*	
	Sheet Fabrication 3 (Parallel Line) *FAB2100*	Sheet Fabrication 4 (Radial Line) *FAB3090*	
Fabrication Principles ★ ◆ *FAB1100*	Forging Fundamentals ◆ *FAB2110*	Sheet Fabrication 5 (Duct Components) *FAB3110*	
Foundry 1 (One-piece Pattern) ◆ *FAB1120*	Foundry 2 (Split Pattern) *FAB2120*	Foundry 3 ◆ (Core Molding) *FAB3120*	Production Systems and Processes
Principles of Machining ◆ *FAB1130*	Precision Turning 1 *FAB2130*	Precision Turning 2 *FAB3130*	
	Precision Milling 1 *FAB2140*	Precision Milling 2 *FAB3140*	
	CNC Turning (Computer Numerical Control) *FAB2150*	CNC Milling ◆ (Computer Numerical Control) *FAB3150*	
Production Systems ◆ *FAB1160*	Custom Fabrication ◆ *FAB2160*	Prefabrication Principles *FAB3160*	

——— Prerequisite - - - - - Recommended sequence

★ Course provides a strong foundation for further learning in this strand.

◆ Refer to specific courses for additional prerequisites.

COURSE DESCRIPTIONS

Course FAB1010: Fabrication Tools & Materials
Students develop knowledge and skills in the use of basic hand tools and materials used in fabrication processes, and safely transform common metals into useful products.

Course FAB1040: Oxyacetylene Welding
Students develop basic skills in the safe handling and operation of oxyacetylene equipment.

Course FAB1050: Basic Electric Welding
Students develop basic skills related to safe use and operation of one or more common electric welding processes.

Course FAB1090: Sheet Fabrication 1 (Hand Processes)
Students use basic tools, materials and processes to fabricate sheet materials into finished products, models or prototypes.

Course FAB1100: Fabrication Principles
Students investigate and apply fundamental principles of fabrication to build an artifact or structure from common structural materials.

Course FAB1110: Bar & Tubular Fabrication
Students use cutting, bending and fastening processes to create a variety of products from bar and tubular stock.

Course FAB1120: Foundry 1 (One-piece Pattern)
Students develop the basic skills required to produce a simple one-piece pattern, a sand mold and a finished casting.

Course FAB1130: Principles of Machining
Students develop basic hand and machine tool knowledge, skills and techniques to mechanically remove materials.

Course FAB1160: Production Systems
Students investigate and compare the principles of production operation and the characteristics of a number of production systems.

Course FAB2010: Structural Engineering
Students investigate the nature of forces and structural materials, and apply their findings to design and fabrication activities.

Course FAB2020: Print Reading
Students develop basic skills in reading and interpreting working drawings to prepare a bill of materials and sequence of operations.

Course FAB2030: Oxyfuel Welding
Students develop basic skills in the safe and efficient use of oxyfuel equipment and supplies to braze and fusion weld.

Course FAB2040: Thermal Cutting
Students develop basic skills to use, safely and efficiently, thermal cutting equipment and supplies.

Course FAB2050: Arc Welding 1
Students develop basic knowledge, skills and attitudes related to the operation and use of shielded metal arc welding (SMAW) equipment and accessories to make a variety of welds in the flat position.

Course FAB2060: Arc Welding 2
Students identify appropriate electrodes, visually assessing a weld, and making the necessary adjustments to improve weld quality while developing horizontal position welding skills.

Course FAB2070: Gas Metal Arc Welding 1
Students build a knowledge and skill base related to gas metal arc welding (GMAW) that has both personal use and commercial applications.

Course FAB2090: Sheet Fabrication 2 (Machine Processes)
Students use basic layout, cutting, bending and fastening operations to transform common types of sheet metals into consumer products.

Course FAB2100: Sheet Fabrication 3 (Parallel Line)
Students expand sheet metal skills related to pattern making, seam constructing and edge treating.

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Course FAB2110: Forging Fundamentals
Students determine the effects of heating and striking metal to change its shape and internal structure, using forging techniques.

Course FAB2120: Foundry 2 (Split Pattern)
Students expand their pattern making and foundry skills to produce split pattern molds and finished castings.

Course FAB2130: Precision Turning 1
Students develop basic turning skills to size, shape and finish common machineable metals and plastics.

Course FAB2140: Precision Milling 1
Students develop basic milling skills to shape and finish common machineable metals and plastics.

Course FAB2150: CNC Turning (Computer Numerical Control)
Students develop skills in computer assisted design (CAD) and computer numerical control (CNC) programming to manufacture a product on a CNC lathe.

Course FAB2160: Custom Fabrication
Students work independently, or in a cooperative learning environment, to plan and construct a product/structure that meets a specific client's needs.

Course FAB2170: Pipe Fitting
Students learn about the uses of pipes, basic piping principles and fabrication skills.

Course FAB3010: Materials Testing
Students are introduced to the principles of materials testing, and to the development and evaluation of a mechanical materials test.

Course FAB3020: Metallurgy Fundamentals
Students develop fundamental understandings and skills related to metallurgy, and apply these skills to fabrication processes.

Course FAB3030: Gas Tungsten Arc Welding
Students develop basic knowledge and skills related to the use of gas tungsten arc welding (GTAW) equipment and supplies to weld mild steel in the flat and horizontal positions.

Course FAB3040: Specialized Welding
Students develop specific skills associated with advanced welding techniques to join and repair metals other than low carbon steel.

Course FAB3050: Arc Welding 3
Students learn the role of codes and standards in the welding trade, as well as test welds and develop vertical position welding skills.

Course FAB3060: Arc Welding 4
Students apply and extend positional welding skills, by using a variety of common electrodes and thickness of materials.

Course FAB3070: Pipe & Tubular Welding
Students develop specific skills related to pipe layout, preparation of pipe/tube joints and welding techniques.

Course FAB3080: Automated Welding
Students investigate and describe the operation of various manual, semi-automated and automated welding processes and systems used in fabrication industries.

Course FAB3090: Sheet Fabrication 4 (Radial Line)
Students develop specialized skills in cylindrical and conical pattern development and seam construction of ferrous and nonferrous sheet metals.

Course FAB3110: Sheet Fabrication 5 (Duct Components)
Students apply and develop specialized skills in duct component pattern making and fabrication techniques.

Course FAB3120: Foundry 3 (Core Molding)
Students investigate and apply advanced foundry processes to produce a hollow casting, using a sand and core mold.

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Course FAB3130: Precision Turning 2
Students develop specialized lathe skills for thread cutting and taper turning techniques.

Course FAB3140: Precision Milling 2
Students develop specialized skills to use vertical and/or horizontal milling machines.

Course FAB3150: CNC Milling (Computer Numerical Control)
Students develop skills in computer numerical control (CNC) programming to manufacture a three-dimensional product.

Course FAB3160: Prefabrication Principles
Students work in a cooperative learning environment to plan and construct a prefabricated product/structure to meet the specific needs of a client.

Course FAB3170: Gas Metal Arc Welding 2
Students develop specific skills to assess and improve the quality of gas metal arc welding (GMAW) processes, and gain experience using flux cored arc welding (FCAW) processes.

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SECTION C: PLANNING FOR INSTRUCTION

CTS provides increased opportunity for junior and senior high schools to design courses based on the needs and interests of their students and the circumstances within the school and community. Some strands may be appropriately introduced at the junior high school level. Other strands are more appropriately introduced at the senior high school level or to Grade 9 students. Refer to this section for recommendations regarding the Fabrication Studies strand.

PLANNING FOR CTS

Defining Courses

Schools determine which strands and courses will be offered in a particular school, and will combine 1-credit CTS courses into multiple-credit CTS offerings.

Each 1-credit course was designed for approximately 25 hours of instruction. However, this time frame is only a guideline to facilitate planning. The CTS curricula are competency based, and the student may take more or less time to gain the designated competencies within each course.

A multiple-credit CTS offering will usually consist of 1-credit courses primarily from the same strand but, where appropriate, may include courses from other CTS strands. Refer to the *Guide to Education: ECS to Grade 12* (Appendix 1) for more information on course names and course codes.

Course selection and sequencing should consider:

- prerequisite(s)
- supporting course(s) (other CTS courses that may enhance the learning opportunity if offered with the course)
- course parameters
  - instructional qualifications, if specialized
  - equipment and facility requirements, if specialized.

The course parameters are defined in Sections D, E and F of this Guide.

Degree of Flexibility

The CTS program, while designed using the modular structure to facilitate flexible timetabling and instructional delivery, does not mandate the degree of flexibility a school or teacher will offer. The teacher and school will determine the degree of flexibility available to the student. Within the instructional plan established by the school, the student may:

- be given the opportunity to progress at a rate that is personally challenging
- have increased opportunity to select courses that develop competencies he or she finds most relevant.

Integrating Basic Competencies

The basic competencies relate to managing learning and resources, problem solving and innovation, communicating effectively, working with others and demonstrating responsibility are developed throughout the CTS program, and within each 1-credit course.

Assessment of student achievement on the basic competencies, is integrated throughout the other general outcomes. Refer to Section G (Assessment Tools) of this Guide for the description of student behaviours expected at each of the four developmental stages defined for the basic competencies.

Assessment of basic competencies could include input and reflection involving the student, teacher(s), peers and others. Description of the observed behaviour could be provided through a competency profile for the course. Positive, ongoing interaction between the student and teacher will support motivation for student growth and improvement.

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Assessing Student Achievement

Assessing student achievement is a process of gathering information by way of observations of process, product and student interaction.

Where appropriate, assessment tools have been defined to assist the teacher and student in the assessment. Refer to Section G (Assessment Tools) of this Guide for copies of the various tools (worksheets, checklists, sample questions, etc.).

A suggested emphasis for each general outcome has also been established. The suggested emphasis provides a guideline to help teachers determine time allocation and/or the appropriate emphasis for each general outcome and the student grade.

Recognizing Student Achievement

At the high school level, successful demonstration of the exit-level competencies in a course qualifies the student for one credit. Refer to Section A of this Guide for more detailed information about how curriculum and assessment standards are defined in CTS. Refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* for more information on how student achievement can be recognized and reported at the school and provincial levels.

Portfolios

When planning for instruction and assessment, consider a portfolio as an excellent tool to provide evidence of a student's effort, progress and achievement. Portfolios will aid students in identifying skills and interest. They also provide the receiving teacher, employer and/or post-secondary institution proof of a student's accomplishments. The make-up and evaluation of the portfolio should be a collaborative agreement between the student and teacher.

Resources

A comprehensive resource base, including print, software and audio-visual, has been identified to support CTS strands. It is intended that these resources form the basis of a resource centre, encouraging teachers and students to access a wide selection of resources and other information sources throughout the learning process. Unless otherwise noted, these resources are considered to be suitable for both junior and senior high school students.

Refer to Section I (Learning Resource Guide) to obtain directions for accessing up-to-date information about learning resources that have been identified to support the delivery of CTS courses in this strand.

Sample Student Learning Guides

In addition to the resources, Sample Student Learning Guides are available (refer to Section J of this Guide). These samples, designed for individual student or small group use, provide an instructional plan for selected courses and include the following components:

- Why take this course?
- What are the entry-level competencies?
- What are the exit-level competencies?
- What resources may be accessed?
- What assignments/activities must be completed?
- What are the timelines?
- How will the final mark be calculated?

Sample Student Learning Guides have been developed for the following courses in Fabrication Studies.

- FAB1010 Fabrication Tools & Materials
- FAB2010 Structural Engineering
- FAB3010 Materials Testing
- FAB3160 Prefabrication Principles.

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Community Resources

The community can become a major stakeholder and effective partner in the learning process. The use of community members and resources should be integrated into course planning. Business, industry and government agencies offer a wide range of services and resources, as do local clubs, service groups and institutions. When planning for the use of community resources, teachers should ensure that related presentations, activities and work settings:

- are consistent with student knowledge and skill levels
- demonstrate sound pedagogy
- are exemplary of approved health and safety standards
- provide a balanced approach to curriculum topics and related issues.

Off-campus Excursions

Field excursions are also recommended and should be an important part of teaching and learning throughout the Fabrication Studies strand. Safety must be a prime consideration in planning off-campus learning experiences. Both teachers and students should engage in activities commensurate with their level of training and ability. Adequate instructional support, guidance and supervisor must be provided at all times. Local jurisdiction and school policies must be understood and observed by principals, teachers, parents, supervisors and students.

PLANNING FOR FABRICATION STUDIES

The following suggestions are provided to assist teachers, school and school system administrators as they plan to deliver courses in the Fabrication Studies strand.

Teaching Strategies

A practical "hands on" approach, where theory and practise are developed in concert with one another, is encouraged throughout Fabrication Studies. When teaching content in an applied setting, lecture-type classes should be avoided as much as possible. Teachers should attempt to integrate theory and practice by engaging students in practical experiences. Students that work on meaningful assignments and useful projects are more easily motivated to develop the required knowledge, skills and attitudes outlined in each course. Refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* for additional teaching strategies.

Health and Safety and Related Legislation

The health and safety of students and teachers is protected by law. Every worker has the right to be protected from injury and needs to know how to safely use, store and transport hazardous materials. Teachers of Fabrication Studies must ensure that students are working in a safe and healthy environment. Students should therefore be encouraged to work in a safe manner and identify and report existing and potential hazards within the learning environment. Accident prevention is one of the most important concepts a student learns in the Fabrication Studies strand.

Teachers of Fabrication Studies courses should also be aware of the issues addressed in the *Occupational Health and Safety Act*, Worker's Compensation regulations and local fire and building codes related to this strand.

Off-site Risk Management

Safety and risk management involves exercising situation-specific judgement throughout the course of an off-campus excursion. Judgement is the product of experience, and may include recognizing factors such as dangers imposed by equipment, a decline in physical strength, or a more challenging task. Many of the hazard recognition skills can be taught in the classroom in the preparation stage.

A significant aspect of off-site risk management is group management. Teachers can exercise appropriate group management strategies by focusing attention on:

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- pacing and observation distance, including speed of travel, rest stops, distance travelled and maintaining safe distance for observations
- group control, including position of leader, regrouping procedures, signal systems and buddy systems
- the establishment of group rules and norms
- clearly defined task allocations for each student
- objective hazard recognition on the site, including machinery and equipment.

For additional information on health and safety standards in CTS, refer to the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers.*

Instructional Qualifications

Responsibility for instructional planning and delivery of courses in Fabrication Studies will be assumed by Alberta certified teachers having expertise in fabrication processes. See specific courses and the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* for more detailed information regarding instructional qualifications. Note that where courses or portions of courses require special instructional qualifications, complete courses or portions of courses can be delivered through off-campus learning under the supervision of a certified teacher.

Many of the competencies developed in Fabrication Studies relate directly to a number of recognized trade areas. The *Alberta Apprenticeship and Training Act* clearly outlines who can or cannot work in compulsory and optional trade areas. The Act states: *A person shall not work in a compulsory or optional trade area unless that person:*

a. holds a trade certificate
b. is an apprentice in the specified trade
c. is authorized under Section 23 to work or perform one or more tasks in the trade
d. is a student in a student work training program in that trade.

In addition, in an optional certificated trade area, a person who does not hold a trade certificate, may work in or perform one or more tasks, activities or functions if the employer is satisfied that the person possesses the skills and knowledge in the trade as would be expected from one who would be in possession of a trade certificate.

It should also be noted that the Act spells out the ratio of journeyman to apprentices is a minimum of one apprentice to each journeyman employed. This ruling applies specifically to the Registered Apprenticeship Program.

Selecting Courses

Course planning should take into consideration both physical and human resources present in the school and community.

The scope and sequence chart in Section B of this Guide provides an overview of the Fabrication Studies courses, indicating prerequisites and theme areas. In addition, a brief description of each course can be found in this section following the scope and sequence chart.

Fabrication Studies in Junior High

Most introductory level courses may be offered to junior high school students. Since resources and expertise will vary in each school and community, it is important to assess potential support networks before selecting specific courses and course sequences.

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The number of courses offered will vary according to the time available throughout Grades 7, 8 and 9 as outlined below:

Time Available	Courses
25 hours	**Fabrication Tools & Materials**
50 hours	*add to the previous course* **Fabrication Principles**
75 – 100 hours	*add one or two of the following:* **Sheet Fabrication 1** **Bar & Tubular Fabrication** **Principles of Machining** **Production Systems**

Where appropriate, junior high school students may study intermediate level courses, particularly in the Materials and Structures theme.

Fabrication Studies in Senior High

Depending on the interest and intent of the students, courses in Fabrication Studies may be clustered in a variety of ways. Students with a general interest in the strand may wish to study courses from the various themes, while those with specific interests may focus on a cluster of courses related to welding, sheet metal, foundry or machining as outlined in the Scope and Sequence chart.

As in all CTS strands, students will identify, explore and prepare for future career opportunities. It is recommended that instructional planning include the integration of relevant career investigations throughout each course, rather than in a singular or isolated study. Career profiles, interviews and job shadowing will acquaint students with the many technical and professional careers associated within the field of fabrication.

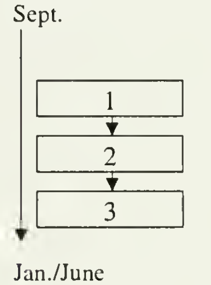
Students intending to continue their studies in a post-secondary institution and/or through apprenticeship should be aware of the post-secondary and apprenticeship linkages referred to in Section H of this Guide. For example, basic to most trade-related programs is the need to have well-developed print reading and hand-tool skills. Such considerations will affect course selection.

When selecting courses, teachers should refer to the parameters defined for each course in Sections D, E and F of this Guide.

Organizing for Learning

Individual 1-credit courses can be delivered sequentially, concurrently or combined as outlined below:

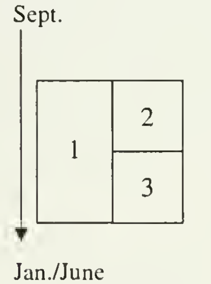
Scenario A



Courses may be taught sequentially, e.g.:

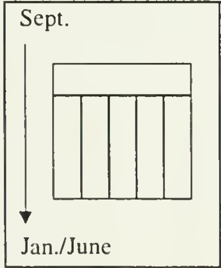
Principles of Machining
↓
Precision Turning 1
↓
Precision Turning 2

Scenario B



One course, such as Print Reading, may be taught throughout the course (e.g., 20 minutes per class), in conjunction with two other courses.

Scenario C



All students take one or two common courses together, such as Basic Electric Welding, and then are able to select from a series of Arc Welding or Gas Metal Arc Welding courses made available to them.

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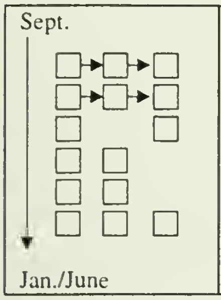
Teachers can also allow students to progress at a rate that is personally challenging; e.g.:

Scenario D



From a list of courses identified by the teacher, the students select which ones they will work on and, in consultation with the teacher, establish timelines for completion and submission of assignments, etc.

Identifying Linkages

Section H of this Guide describes some possible linkages between the Fabrication Studies strand and:

- other CTS strands
- complementary programs, such as art and drama
- core programs; e.g., mathematics, science, social studies and language arts
- off-campus programs.

Note that project courses from the Career Transitions strand may be combined with courses from the Fabrication Studies strand to provide increased opportunity for students to develop expertise and refine their competencies. Project courses are **not** designed to be offered as distinct courses and should **not** be used to extend Work Experience 15, 25 and 35 courses.

Improving Smooth Transitions to the Workplace and/or Post-secondary Programs

As in other CTS strands, students will develop awareness of and prepare for future career opportunities. It is recommended that program planning include the integration of relevant career information and experiences. Through the development of career-specific skills, occupational profiles and on-site activities should be used to help students become aware of training requirements and career opportunities related to the fabrication sector of the economy.

Refer to Section H of this Guide for potential transitions students may make into the workplace and/or related post-secondary programs or other avenues for further learning.

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COURSE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION D: INTRODUCTORY LEVEL

The following pages define the curriculum and assessment standards for the introductory level of Fabrication Studies.

Introductory level courses help students build daily living skills and form the basis for further learning. Introductory courses are developed for students who have no previous experience in the strand.

General outcomes define the competencies a student must demonstrate to achieve success in a course. Assessment standards define the criteria and conditions to be used for assessing the competencies defined in the general outcomes.

Specific outcomes provide a detailed framework for instruction to help students build the competencies defined in the general outcomes. Additional information and suggestions for instruction are provided in the Notes column; teachers may wish to use this space to record their ideas for instruction or student projects.

Course FAB1010: Fabrication Tools & Materials D.3
Course FAB1040: Oxyacetylene Welding D.7
Course FAB1050: Basic Electric Welding D.11
Course FAB1090: Sheet Fabrication 1 (Hand Processes) D.15
Course FAB1100: Fabrication Principles D.19
Course FAB1110: Bar & Tubular Fabrication D.23
Course FAB1120: Foundry 1 (One-piece Pattern) D.27
Course FAB1130: Principles of Machining D.31
Course FAB1160: Production Systems D.37

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COURSE FAB1010: FABRICATION TOOLS & MATERIALS

Level: Introductory

Theme: Materials and Structures

Prerequisite: None

Description: Students develop knowledge and skills in the use of basic hand tools and materials used in fabrication processes, and safely transform common metals into useful products.

Parameters: Access to a materials work centre complete with basic hand tools.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe the safe use of basic hand tools used in fabricating an artifact or structure	• the identification and description of 20 basic hand tools used in fabrication processes; basic hand tools to include two or more: – measurement and layout tools – cutting and boring tools – assembly and dismantling tools – abrading and sharpening tools. *Assessment Tool* *Presentations/Reports: Hand Tools, FAB1010–1* *Illustrative Example: Hand Tool Presentation, FAB1010–2* *Standard* *Correct identification and description of 16 basic hand tools* *Performance rating of 1 for each applicable task*	15
• identify and compare the properties of common ferrous and nonferrous metals used in fabrication processes	• a presentation or report that explains the properties, applications and different processes used in assembling/fastening: – low-, medium- and high-carbon steels – alloy steels – nonferrous metals and their alloys. *Assessment Tool* *Presentations/Reports: Material Identification, FAB1010–3* *Standard* *Performance rating of 1 for each applicable task*	15

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• apply fabrication processes and skills in a safe manner to produce a useful product	• demonstration of safe processes and skills to plan, fabricate, assemble and finish a useful product. *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD* *Standard* *The product is made according to the prepared drawing and event sequence; tools and materials are used according to accepted safe practice* *Performance rating of 1 for each applicable task*	70
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Tools and Equipment	• identify and describe basic hand tools that are used to measure, mark, hold, cut, form, fasten and finish materials • identify and describe basic tools and equipment used in one or more fabrication processes; e.g.: – welding – bar, tubular and sheet fabrication – foundry operations – machining	Introduce students to the safe use of manually operated and power assisted hand tools and equipment.
• Materials	• identify and compare the properties of a variety of ferrous and nonferrous metals used in fabrication processes • identify common shapes, sizes and forms of fabrication materials.	Discuss reasons for choosing one metal over another for a given application.

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Concept	Specific Outcomes	Notes
	The student should:	
• Health and Safety	• describe appropriate methods to handle, recycle, store and dispose of materials • identify and demonstrate the appropriate use of personal protective equipment • identify steps to be taken in the event of an accident	Help students evaluate the short- and long-term impact of the choice of a material on the health of individuals and the environment.
• Production Systems	• outline the typical phases in a production system; e.g.: – planning – fabricating – assembling – finishing – evaluating.	Compare those activities to the input, process, output and feedback mechanisms described in other technological systems.
Planning and Management		
• Product Development	• select or modify a plan for a simple product that will meet a defined need • identify and select the appropriate tools, materials and processes required to make the product • list the steps that are required to make a product in a safe and logical order.	Students are more highly motivated if they can choose and personalize a project.
Implementation		
• Material Processing	• develop basic fabrication skills by building, assembling and finishing a variety of products.	
Assessment		
• Product Quality	• describe ways to improve product quality and productivity	Students should be encouraged to make reflective notes and keep a record of their completed work.
• Career Preparation	• create a record of completed activities within a portfolio.	

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COURSE FAB1040: OXYACETYLENE WELDING

Level: Introductory

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students develop basic skills in the safe handling and operation of oxyacetylene equipment.

Parameters: Access to a materials work centre complete with oxyacetylene welding equipment and fabrication facilities, and to instruction from an individual with formal specialized training in basic oxyacetylene welding.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• recognize health and safety hazards associated with oxyacetylene welding (OWA), and take preventive measures to avoid accidents and personal injury to self and others	• ongoing observed performance related to: – appropriate selection and use of personal protective equipment – maintenance of a clean and tidy workstation – safe use of equipment and materials. *Assessment Tool* *Fabrication Process: Basic Oxyacetylene Welding, FAB1040–1* *Standard* *Performance rating of 1 for each applicable task*	10
• perform safe oxyacetylene start-up and shut-down procedures	• demonstration of safe start-up and shut-down procedures, using Oxyacetylene Welding (OAW) equipment. *Assessment Tool* *Equipment Checklist: OAW Start-up and Shut-down Procedures, FABEQUIP–5* *Standard* *All procedures to be performed correctly*	20

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COURSE FAB1040: OXYACETYLENE WELDING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic oxyacetylene welding competencies	• creation of successive lines of fusion with and without filler rod • completion of two successive fillet welds in the flat position using a variety of material thicknesses and filler rod diameters. *Assessment Tool* *Fabrication Process: Basic Oxyacetylene Welding, FAB1040–1* *Illustrative Example: Basic Oxyacetylene Welding, FAB1040–2* *Standard* *Beads are to be slightly convex and uniform in width and height. Ripples are close, bullet shaped and free of voids, evidence of undercutting and overlapping. Penetration should be even throughout the weld* *Performance rating of 1 for each applicable task*	70
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation • Oxyacetylene Welding	• describe how oxygen and acetylene gases are produced, stored and transported • analyze the construction of a oxygen and acetylene cylinder • explain the purpose and operation of a gas regulator and welding torch • match the type of gas with the appropriate type of hose, cylinder and threaded connection	Even though oxyacetylene welding is not used extensively in industry, it is an excellent medium to teach basic welding principles and skills.

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Oxyacetylene Welding (continued)	• describe how welding tips are sized • describe how welding tips are cleaned	
	• describe the characteristics of: – an oxidizing flame – a carburizing flame – a neutral flame	Review the parts of a flame and demonstrate where the greatest amount of heat is produced.
• Weld Joints, Position and Types	• identify typical weld types; e.g.: – fillet – groove – plug • identify typical weld positions; e.g.: – flat – horizontal – vertical – overhead • list and describe the basic weld joints; e.g.: – butt – lap – tee – corner – edge	
• Health and Safety	• describe the hazards associated with oxyacetylene welding in relation to: – use of personal protective equipment – use of flammable gases under pressure – the need to remove or protect all combustible materials around the welding area • describe a plan of action in the event of an accident.	Explain the importance of **not** allowing pure oxygen to come in contact with oily or greasy materials under any circumstance.

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Start-up and Shut-down Procedures	• describe and demonstrate the safe start-up and shut-down procedures for oxyacetylene welding • prepare a selection of coupons for welding lap joints • select the appropriate tip for a given application • identify appropriate gas pressure for proper flame control • identify the appropriate fire extinguisher in the event of a fire.	In this module, students are not expected to set up the welding equipment; however, they are expected to demonstrate safe start-up and shut-down procedures.
Implementation		
• Fusion Welding	• demonstrate proficiency in: – creating lines of fusion without using a filler rod – creating lines of fusion with filler rod – welding fillet welds in the flat position.	Students should gain experience welding various thicknesses of materials using different diameters of filler rods and welding tip sizes.
Assessment		
• Quality Control	• complete a visual inspection of a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion and degree of undercutting and overlapping	Have students identify the defects in unacceptable welds and suggest ways to overcome these imperfections.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1050: BASIC ELECTRIC WELDING

Level: Introductory

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students develop basic skills related to safe use and operation of one or more common electric welding processes.

Parameters: Access to a materials work centre complete with electric welding equipment and fabrication facilities, and to instruction from an individual with formal specialized training in basic gas metal and/or shielded metal arc welding.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• recognize health and safety hazards associated with electric welding processes, and preventive measures to avoid accidents and personal injury to self and others	• observed performance in a typical work setting, related to: – appropriate selection and use of personal protective equipment – maintenance of a clean and tidy workstation – safe use of equipment and materials. *Assessment Tool* *Fabrication Process: Electric Welding, FAB1050–1* *Standard* *Performance rating of 1 for each applicable task*	10
• perform safe gas metal and/or shielded metal arc welding start-up and shut-down procedures	• demonstration of consistent safe start-up and shut-down procedures using Shielded Metal Arc Welding (SMAW) and/or Gas Metal Arc Welding (GMAW) equipment. *Assessment Tool* *Equipment Checklist: GMAW Start-up and Shut-down Procedures, FABEQUIP–6* *Standard* *All procedures to be performed correctly*	20

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COURSE FAB1050: BASIC ELECTRIC WELDING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic arc welding competencies	• the creation of successive stringer and weave beads and the completion of light gauge fillet welds in the flat position using SMAW and/or GMAW equipment. *Assessment Tool* *Fabrication Process: Electric Welding, FAB1050–1* *Illustrative Example: Flat Lap Joint Fillet Weld, FAB1050–2* *Standard* *Beads and welds should be slightly convex, free of voids, undercutting and high spots. Ripples should be uniform and evenly spaced. Adequate fusion should exist between the bead and the base metal* *Performance rating of 1 for each applicable task*	70
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Electric Welding	• identify and describe the common electric welding processes and approved abbreviations; e.g.: – Gas Metal Arc Welding (GMAW) – Gas Tungsten Arc Welding (GTAW) – Shielded Metal Arc Welding (SMAW) • Flux Cored Arc Welding (FCAW) describe how an arc is produced and controlled in GMAW and/or SMAW	Students should realize that GMAW and FCAW processes are gaining in importance over other forms of welding. Discuss the need for the correct arc length, current, travel speed and electrode angle.

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Electric Welding (continued)	• explain the purpose of the electrode coating and/or shielding gas in their respective processes • identify the essential components and accessories used in gas metal and/or shielded metal arc welding	Have the students understand the need to protect the weld from atmospheric contamination.
• Weld Joints Position and Types	• identify typical weld types; e.g.: – fillet – groove – plug or slot – stud • identify typical weld positions; e.g.: – flat – horizontal – vertical – overhead • list and describe the basic weld joint; e.g.: – butt – lap – tee – corner – edge	
• Health and Safety	• describe the hazards associated with gas metal and shielded metal arc welding • demonstrate how personal protective equipment is used to protect eyes, skin and respiratory system • describe a safety plan in case of an accident	Demonstrate appropriate methods to set up equipment and strike an arc.
• Fire Prevention	• describe the need to remove or protect all combustible materials in the welding area • identify and locate the appropriate fire extinguisher and fire blanket.	As part of an ongoing expectation, students should be able to describe a plan of action in the event of a fire or accident.

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Weld Specifications	• describe from a weld specification the: – type of equipment to be used – size and type of electrode/wire – weld settings – type of weld, joint and weld position – weld dimensions	For students just beginning to arc weld E6013 and/or E7014 electrodes are recommended.
• Weld Preparation	• prepare weld surfaces by removing any: – oil and/or grease – paint, rust or scale	
	• describe the start-up and shut-down procedures for a given piece of equipment	
	• locate all pertinent safety equipment and clamping apparatus.	
Implementation		
• Electric Welding	• demonstrate basic skills in: – selecting equipment and accessories – setting machine parameters – connecting work leads – striking an arc using a tapping and scratching technique – running a stringer and weave bead – performing fillet welds in the flat position using SMAW, GMAW and FCAW processes.	It is understood that students will require practice time to develop their skills using coupons and scrap material. However, as much as is possible, students should be allowed to develop these skills by fabricating simple products.
Assessment		
• Quality Control	• complete a visual inspection of a weld by considering the overall appearance, size and shape of the bead	
• Career Information	• research and describe examples of personal and trade-specific application of electric welding	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1090: SHEET FABRICATION 1 (HAND PROCESSES)

Level: Introductory

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students use basic tools, materials and processes to fabricate sheet materials into finished products, models or prototypes.

Parameters: Access to a materials work centre complete with basic hand tools.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe basic tools and processes used to fabricate sheet stock	• identification, description and use of a basic set of sheet fabrication tools to include one or more: – measurement and marking tools – layout and squaring tools – cutting and drilling tools – fastening and forming tools. *Standard* *Accurate identification and description of 10 tools used in sheet stock fabrication*	10
• demonstrate basic measurement and layout skills and techniques	• application of measurement and layout techniques to create a pattern or template that is ±1 mm of the original plan	30
• apply basic sheet stock fabrication skills and techniques to produce a product	• successful completion of a sheet stock product that uses appropriate separating, combining and forming techniques associated with a given material. *Assessment Tool* *Product Assessment: Working with Sheet Stock, FAB1090–1* *Standard* *The product should be structurally sound, free of surface defects and conform to the overall size and shape requirements* *Performance rating of 1 for each applicable task*	60

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COURSE FAB1090: SHEET FABRICATION 1 (HAND PROCESSES) (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Sheet and Board Stock	• identify the common types and sources of sheet and board stock; e.g.: – card stock – sheet metal – acrylic plastic – corrugated card and plastic – foam board – styrofoam	By working with a variety of sheet materials, students can better understand the working properties.
• Layout and Marking Processes	• identify and demonstrate the appropriate transfer and marking processes for a variety of sheet and board materials	
• Cutting Sheet Stock	• describe the process of separating sheet stock by: – shearing – scoring and snapping – sawing – hot wire cutting	Students will require a lab demonstration of these processes.
• Bending and Forming	• describe the process of forming sheet stock using a: – strip heater – box and pan brake – slip roll – vacuum former.	

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MODULE FAB1090: SHEET FABRICATION 1 (HAND PROCESSES) (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Combining Sheet Stock	• research typical joining and fastening techniques related to the use of: – mechanical joints and fasteners – adhesive – cohesives.	
Planning and Management		
• Operation Sequencing	• prepare a pattern or template to transfer folding and cutting lines • create a systematic sequence of operations to fabricate a product.	
Implementation		
• Material Processing and Fabrication	• demonstrate basic skills related to the use of: layout and marking tools – cutting tools – forming tools – bonding materials – fastening devices	Consider the use of sheet stock to make models of products
• Finishing	• apply suitable finishes and surface details to a model, prototype or product.	
Assessment		
• Quality Control	• analyze a product for the overall attention to: – workmanship – accuracy – structural soundness – quality of finish	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1100: FABRICATION PRINCIPLES

Level: Introductory

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students investigate and apply fundamental principles of fabrication to build an artifact or structure from common structural materials.

Parameters: Access to a materials work centre complete with basic hand tools.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe the principles of separating, forming and combining materials	• written or oral response that accurately describes the processes used in fabricating a product, such as separating, forming and combining (joining) techniques. *Assessment Tool* *Response Assessment: Principles of Fabrication, FAB1100–1* *Standard* *Response rating of 1*	10
• describe the characteristics and give examples of permanent, semipermanent and temporary fastening systems	• analysis of a given fastening technique in relation to its: – serviceability – strength – appearance – ease and cost of production. *Assessment Tool* *Issue Analysis: Fastening Systems, FAB1100–2* *Standard* *Performance rating of 1 for each applicable task*	15

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic fabrication skills and techniques, using simple hand and power tools	• the completion of a simple product that uses one or more separating, forming and combining (joining) techniques. *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD* *Standard* *The product should meet or exceed an "acceptable" level of quality and be completed within the appropriate time and cost limitations* *Performance rating of 1 for each applicable task*	75
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation • Measuring and Layout	• identify and describe measurement and layout tools that can be used to: – measure and mark a straight line on a metal surface – make an angle of 45° and 90° – create arcs and circles – measure the inside and/or outside dimensions of pipe, round and square stock	This course covers many of the bench metal practices. It can be taught along with other Fabrication Studies courses.

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Shaping Materials	• list and describe three distinct ways of changing the shape of a material; e.g.: – separating – forming – combining (joining)	Use available equipment to illustrate these processes.
• Separating	• describe and give examples of tools that: – shear – chip – abrade	
	• identify other current and emerging processes that use: – heat – light – chemicals to shape a material	
• Forming	• outline principal methods of forming materials by: – bending or twisting – forging – casting	
• Combining	• list and describe common types of mechanical fasteners that are used with metal products	This is a good place to introduce students to soldering and resistance welding techniques; conventional welding is covered in other introduction modules.
	• identify and describe typical bonding techniques that are used to combine metals; e.g.: – soldering – braze welding – bonding	
	• describe when to use permanent, semipermanent and temporary fastening techniques	Threaded fasteners are a good example of temporary fasteners. Consider thread cutting using a tap and die set at this point.
• Conditioning	• explain why it may be necessary to change the physical state of some materials before they can be formed	

MODULE FAB1100: FABRICATION PRINCIPLES (continued)

Concept	Specific Learner Expectations	Notes
• Finishing	*The student should:* • research processes that can be used to: – polish – coat – plate a surface to protect or improve the appearance of a product.	
Planning and Management • Health and Safety	• describe principles of shop safety • describe a safety plan in case of accident	
• Process Identification	• for a given product design, describe the appropriate processes and tools to measure, layout, shape, condition and finish the materials • prepare a material list and sequence of events to fabricate a given product design.	Products to consider include: – key fob – pendant – trivet – paperweight – tray – box.
Implementation • Material processing	• demonstrate basic skills related to separating, combining and forming processes.	
Assessment • Career Information	• list and describe a variety of occupations and trades related to metal fabrication	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1110: BAR & TUBULAR FABRICATION

Level: Introductory

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students use cutting, bending and fastening processes to create a variety of products from bar and tubular stock.

Parameters: Access to a materials work centre complete with basic hand tools and metal forming equipment.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• list and describe common shapes and sizes of bar and tubular stock	• the presentation of a written report that lists and graphically describes common bar, angle, tube and pipe sizes and shapes. *Assessment Tool* *Presentations/Reports: Bar and Tubular Stock, FAB1110–1* *Standard* *Performance rating of 1 for each applicable task*	10
• demonstrate approved material handling and storage practices	• observed performance related to: – use of personal protective equipment – correct lifting techniques – proper storage of materials and cut-offs	20
• apply basic bar and tubular fabrication skills and techniques to produce a product	• successful completion of a bar and/or tubular product that uses one or more common metal bar or tubular forms. *Assessment Tool* *Product Assessment: Working with Bar Stock, FAB1110–2* *Standard* *The product should be structurally sound, have tight-fitting joints and meet the stated size, shape and finish specifications* *Performance rating of 1 for each applicable task*	70

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COURSE FAB1110: BAR & TUBULAR FABRICATION (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Types of Bar and Tubular Stock	• identify common size and shapes of bar pipe and tubular stock	This course can be combined with other courses, such as FAB1100: Fabrication Principles, FAB2110: Forging Fundamentals and/or a welding course.
• Layout	• identify common methods of laying out and marking stock	Discuss the use of: – a scriber – soapstone – acid pencil – bluing.
• Cutting	• describe typical methods of cutting bar and tubular stock to length • describe the most appropriate way to safely store and handle bar and tubular stock	Demonstrate or describe processes, such as: – flamecutting – abrasive cutting – mechanical cutting – shearing.
• Bending	• describe how to form: – eyes – circles – scrolls – square and zero bend radii using a metal bender • describe how to calculate the bend allowance for bar and tubular stock	

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Bending (continued)	• describe when heat is required to bend a bar or tube	
• Fastening	• research appropriate fastening techniques using: – mechanical fasteners – welding processes	
• Finishing	• describe how to prefinish and finish a bar/tubular product to prevent corrosion and to improve appearance.	Have the students compare the quality of a spray coating to powder coating.
Planning and Management		
• Bend Allowance	• calculate the bend allowance for a given radius	
• Work Scheduling	• create a material list and work schedule from a shop drawing.	
Implementation		
• Health and Safety	• demonstrate the safe use of hand and power assisted equipment • describe health and safety issues associated with the use of finishing materials • describe a safety plan in case of accident	Projects suitable for this module include: – ornamental furniture, – railings – security bars – racks – brackets.
• Material Processing	• demonstrate basic skills related to: – laying out and marking stock – cutting stock to length – bending arcs and angles – fastening components – finishing the product.	
Assessment		
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1120: FOUNDRY 1 (ONE-PIECE PATTERN)

Level:	Introductory
Theme:	Production Systems and Processes
Prerequisite:	FAB1010 Fabrication Tools & Materials
Description:	Students develop the basic skills required to produce a simple one-piece pattern, a sand mold and a finished casting.
Parameters:	Access to a materials work centre complete with foundry supplies and equipment, and to instruction from an individual with specialized training in basic foundry.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• recognize health and safety hazards associated with casting metal, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance in a typical work setting, related to: – appropriate selection and use of personal protective equipment – maintenance of a clean and tidy workstation – safe use of equipment and materials	10
• demonstrate basic pattern making skills to make a one-piece mold	• completion of a simple one-piece pattern. *Assessment Tool* *Product Assessment: Sand Casting, FAB1120–1* *Standard* *The pattern should incorporate the appropriate fillets, sufficient draft to allow for easy extraction and allowance for shrinkage* *Performance rating of 1 for each applicable task*	50

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic sand casting skills, using a one-piece pattern	• completion of a simple open face and/or one-piece casting, using an appropriate foundry sand and foundry metal. *Assessment Tool* *Product Assessment: Sand Casting, FAB1120–1* *Standard* *The mold should have the appropriate gates, vents, riser, spree, sand density and moisture content. The casting is to be clean and free of voids; removal and finish of the gates should not distract from the overall appearance of the product* *Performance rating of 1 for each applicable task*	40
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation • Foundry Processes and Products	• list examples of everyday products that are made by casting	
	• explain how a cast part differs from a forged part	
	• list common metals used to make castings; e.g.: – aluminum – brass – bronze – iron.	With the knowledge that some metals present special hazards such as high melting temperatures, poisonous gases and potential explosive reactions, explain why aluminum is recommended for most school projects.

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Foundry Processes and Products (continued)	• describe the major casting processes; e.g.: – sand casting – die casting – investment casting • identify and describe the parts of a sand mold • describe the advantages and disadvantages of a water-moistened sand and an oil-bonded sand • explain why a flux is used when a metal is melted • identify common tools and equipment used in sand casting	Oil-bonded sands are recommended for school use. They produce less gassing and can be left for several days before pouring.
• Mold Making	• outline the basic procedures used to make a mold with a one-piece pattern	Explain the dangers of using a mold that has too much moisture content and is improperly vented and packed.
• Health and Safety	• describe the operation of a foundry furnace and safe methods of handling and pouring molten metal • list the types of personal protective equipment and the circumstances under which it should be worn • describe a safety plan in case of accident	
• Pattern Making	• list and describe the types of patterns that are used to make sand molds • identify the types of materials that are suitable for making a pattern. • design or locate an article that can be cast using a one-piece pattern • select a suitable pattern making material	Demonstrate how a pattern is made and explain why it is important for a pattern to have the proper draft and shrinkage allowances.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Casting	• describe the kind and amount of metal that is required for a given casting • describe the melting point and appropriate flux for a specified metal • evaluate the quality of sand and foundry metal.	Check to see that these conditions have been met before proceeding.
Implementation • Material Processing	• use the appropriate tools, materials and process to: – make a pattern – condition the sand – create a mold – heat and pour the molten metal – remove and finish the casting.	Students may need to be reminded **not** to over pack the mold. Ensure that the heating and pouring of metal takes place in a well ventilated area and that students use the proper personal protective equipment.
Assessment • Quality Control	• research a completed casting and check to see that it is clean, free of voids and finished appropriately	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1130: PRINCIPLES OF MACHINING

Level: Introductory

Theme: Production Systems and Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students develop basic hand and machine tool knowledge, skills and techniques to mechanically remove materials.

Parameters: Access to a materials work centre complete with drillpress, bench or pedestal grinder and metal lathe, and to instruction from an individual with specialized training in basic machining.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe common machineable materials and machining processes	• accurate identification of three machineable materials and four common machining processes and related tools. *Assessment Tool* *Response Assessment: Machining Materials and Processes, FAB1130–1* *Standard* *Response rating of 1*	10
• perform safe set up, operation and shut down of equipment used in drilling, grinding and turning operations	• demonstration of consistent safe set-up, operating and shut-down procedures using drilling, grinding and turning equipment. *Assessment Tool* *Equipment Checklist: Drill Press, FABEQUIP–1* *Equipment Checklist: Grinder – Bench or Pedestal, FABEQUIP–2* *Equipment Checklist: Metal Lathe, FABEQUIP–3* *Standard* *All procedures to be performed correctly*	20

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic hand and machine tool knowledge, skills and techniques	• application of machining principles to drill holes and remove excess material by grinding. Face and turn round and/or hexagonal stock in a universal three-jaw chuck. *Assessment Tool* *Product Assessment: Basic Machining, FAB1130–2* *Standard* *Dimensions are to be within stated tolerances and surfaces are to be flat and free of cuts and scratches* *Performance rating of 1 for each applicable task*	70
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation • Principles of Machining	• list and describe the principal methods of material removed by: – sawing – shaping – grinding – turning – milling – drilling – buffing • identify common machineable materials; e.g.: – aluminum – mild steel – brass – plastic.	Compare the principles of separating by chip removal and shearing.

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MODULE FAB1130: PRINCIPLES OF MACHINING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Measurement	• describe the current systems of measurement used in machining and explain the advantages and disadvantages of each	
	• list and describe common types of: – rules – squares – dividers – calipers – micrometers – gauges that are used in connection with machining	Discuss the purpose of each of these tools and explain why it is important to take special care of these measuring devices.
• Machine Operations	• research methods of securing stock for purposes of machining; e.g.: – chuck – vise – clamp	
	• analyze common hand and machine tool processes of: – cutting and shaping – grinding and polishing – threading metal stock	
	• compare the performance of manually operated and computer-controlled equipment in relation to: – accuracy – repeatability – reliability – productivity	Even if CNC equipment is not available, students should have a basic understanding of how this equipment operates.
• Drilling	• identify the major components and describe the operation of a drill press	
	• research the design of a typical twist drill and methods of sizing	
	• explain how the proper drill speeds and feeds rate are determined	
	• describe purpose and list the types of lubrication that are used when drilling	
	• list and describe the safety hazards associated with drilling	

MODULE FAB1130: PRINCIPLES OF MACHINING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Turning	• describe the major components and operation of a metal lathe • identify the appropriate cutting tool to face metal stock • explain what is meant by cutting speed, feed rate, depth of cut and how these variables are expressed and controlled • list and describe the safety hazards associated with turning	The emphasis in this module should be on facing and straight turning.
• Abrading	• identify the major components and operation of a bench or pedestal grinder • identify and describe different kinds of grinding wheels • explain why it is important not to overheat thin edges or points, nor to grind soft metals • identify the types and uses of cloth abrasives • list and describe the safety hazards associated with grinding.	Emphasize the importance of having the tool rest properly adjusted and proper wheel guards and eye shield in place. A wheel that has become cracked or loose should **never** be used.
Planning and Management • Product Design	• select or modify a product that incorporates: – drilling – grinding – turning operations • describe the machining operations and sequence them in a logical and efficient manner.	Suggested products include: – pen base – screw driver – simple mallet – simple puller.
Implementation • Machining Processes	• demonstrate basic skills in: – measurement and layout – drilling, grinding and turning operations to size, shape and finish a complete product.	

Concept	Specific Learner Expectations	Notes
Assessment	*The student should:*	
• Quality Control	• research a completed product to determine whether it meets the specified tolerances and quality of finish	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB1160: PRODUCTION SYSTEMS

Level: Introductory

Theme: Production Systems and Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students investigate and compare the principles of production operation and the characteristics of a number of production systems.

Parameters: Access to a materials work centre complete with basic hand and power tools, and to instruction from an individual with specialized training in the use of basic hand and power tools.

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• list and describe common methods of manufacturing durable products	• written or oral report that identifies and describes two or more different methods of manufacturing, such as custom, job-lot, continuous and just-in-time	15
• demonstrate basic production planning and management skills	• collaboratively designed and developed production system that includes: – rationale for the type of system being used – production flow chart – resource and equipment requirements	70
• identify the present and future career opportunities related to the production of durable products	• presentation of a career profile that outlines: – present and future career opportunities – skill requirements – training opportunities. *Assessment Tool* *Presentations/Reports: Planning a Production System, FAB1160–1* *Standard* *Performance rating of 1 for each applicable task*	15

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation • Types of Manufacturing Systems	• list and describe the four basic types of manufacturing systems: – custom – job-lot – continuous – just-in-time	Explain how these manufacturing systems differ from each other.
• Health and Safety	• describe safety rules and guidelines associated with the task and working conditions • identify common hazards associated with the use of a specific tool, machining material or process • inspect for and correct potential hazards within the working environment • describe a safety plan in case of an accident.	
Planning and Management • Choosing a Manufacturing System	• select a manufacturing system based on: – number of products to be produced – availability of resources – type of product – life cycle and durability of a product.	Consider having students work together to produce a product(s) using one of the production systems outlined in this course.

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MODULE FAB1160: PRODUCTION SYSTEMS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Product Design	• explain the importance of: – appeal – ease of manufacture – use of standardized parts – quality – cost when selecting a product	
• Production Engineering	• describe what tools, materials and processes will be required to manufacture the product • help prepare a flow chart that: – combines the worker, machines and materials in an organized unit – requires minimal movement of the worker and materials – identifies specific operations • explain the importance of providing for: – personal and environmental safety – easy access to utilities – ventilation – lighting – waste disposal – material and product handling	
• Production Tooling	• help design jigs, template and fixtures based on: – ease of use – ability to reduce error – cost and safety.	
Implementation • Production Work	• help design, construct, and operate a production system.	
Assessment • Quality Control	• identify when a product is at standard, needs reworking or should be rejected	Discuss the issue of quality control

MODULE FAB1160: PRODUCTION SYSTEMS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Career Information	• identify the career opportunities in the field of manufacturing durable products • describe the impact of technology on the future of careers in the manufacturing sector • analyze personal interests and abilities related to making realistic career choices	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION E: INTERMEDIATE LEVEL

The following pages define the curriculum and assessment standards for the intermediate level of Fabrication Studies.

> Intermediate level modules help students build on the competencies developed at the introductory level and focus on developing more complex competencies. They provide a broader perspective, helping students recognize the wide range of related career opportunities available within the strand.

Module FAB2010: Structural Engineering E.3
Module FAB2020: Print Reading E.7
Module FAB2030: Oxyfuel Welding E.11
Module FAB2040: Thermal Cutting E.15
Module FAB2050: Arc Welding 1 .... E.19
Module FAB2060: Arc Welding 2 .... E.23
Module FAB2070: Gas Metal Arc Welding 1 .... E.27
Module FAB2090: Sheet Fabrication 2 (Machine Processes) E.31
Module FAB2100: Sheet Fabrication 3 (Parallel Line) E.35
Module FAB2110: Forging Fundamentals E.39
Module FAB2120: Foundry 2 (Split Pattern) E.43
Module FAB2130: Precision Turning 1 .... E.47
Module FAB2140: Precision Milling 1 .... E.51
Module FAB2150: CNC Turning (Computer Numerical Control)........ E.55
Module FAB2160: Custom Fabrication E.59
Module FAB2170: Pipe Fitting E.63

COURSE FAB2010: **STRUCTURAL ENGINEERING**

Level: Intermediate

Theme: Materials and Structures

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students investigate the nature of forces and structural materials, and apply their findings to design and fabrication activities.

Parameters: Access to a fabrication work centre complete with basic hand tools.

Supporting Course: FAB1100 Fabrication Principles

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• list and describe the principal characteristics of all structures	• a written or oral report that provides evidence that: – all structures found in nature or in the constructed world share common elements and principles of construction – structural elements provide both shape and support to the structure – forces are dispersed throughout the structure – forces must be kept in balance to keep a structure from failing	20
• identify strategies to improve the efficiency of a structure	• complete analysis of a given structure to show how: – strength can be improved – weight can be reduced – building costs can be reduced	20
• apply principles of structural design to fabrication and construction activities	• safe fabrication/construction of a structure or component that meets overall design requirements in relation to strength, appearance and cost. *Assessment Tool* *Presentations/Reports: Building Structures, FAB2010–1* *Standard* *Assessment will be based on the strength to weight ratio, appearance, cost of materials and ease of construction* *Performance rating of 2 for each applicable task*	60

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General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Characteristics of Structure	• through the analysis of natural and fabricated (synthetic) forms, explain how: – structural elements provide both shape and support – structures are built to withstand forces of nature, applied loads and the weights of the structural components – loads applied to a structure generate forces that must be kept in balance – most structures are built with a margin of safety	Compare the similarities of structure found in nature to those constructed by humans.
• Types of Structures	• identify from natural and synthetic structures examples of: – frame – shell – non-rigid structures	
• Structural Materials	• identify natural and synthetic structural materials that have good: – tensile strength – compressive strength – elasticity	Explain why it is important to understand the properties of a material before it is placed in a structure.
• Structural Elements	• list typical structural components that are used as: – linear elements, such as a beam – vertical elements, such as a column – non-rigid elements, such as a cable	

MODULE FAB2010: STRUCTURAL ENGINEERING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Structural Elements (continued)	• explain the purpose of rigid and non-rigid materials that are used between linear and vertical elements; e.g., plywood and canvas • describe the advantages and disadvantages of non-rigid structures	
• Beam and Truss Construction	• show how triangulation is used to stabilize a truss and rectangular frame • demonstrate the effects of moving a load close to or away from the neutral axis of a beam • compare the connecting limits of adhesive and cohesive materials and rigid fasteners.	
Planning and Management		
• Structural Loading	• describe the effects of the following forces on a simple rigid structure: – compression – tension – shear – bending – twisting • show how internal forces are created to balance external loads • demonstrate the effects one element has on another when it fails	
• Design Application	• analyze an existing structure and redesign it to increase its efficiency by: – reducing weight yet maintaining strength – enhancing its durability and usefulness – reducing material and construction costs.	
Implementation		
• Construction	• fabricate a structure or component using common materials, tools and contemporary design principles.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		
• Quality Control and Efficiency	• analyze and test a structure or component to determine its: – strength to weight ratio – cost efficiency – service and construction limitations	Simple testing devices can be constructed to determine the strength-to-weight ratio.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2020: PRINT READING

Level: Intermediate

Theme: Materials and Structures

Prerequisite: None

Module Description: Students develop basic skills in reading and interpreting working drawings to prepare a bill of materials and sequence of operations.

Module Parameters: Access to appropriate print resources and to instruction from an individual with specialized training in print reading.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe the principal components of a print	• a written or oral response that identifies the correct use of lines, symbols, dimensions and notes on a working drawing	20
• demonstrate basic print reading skills	• the accurate identification of materials, sizes and fabrication process given a working drawing of a machine part, weld, structure or system. *Assessment Tool* *Response Assessment: Print Reading Applications, FAB2020–1* *Standard* *Response rating of 2*	80
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

MODULE FAB2020: PRINT READING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Types of Drawings	• describe the types of drawings that are used to visualize an object pictorially and orthographically	This module can be taught independently or by integrating it with other modules in welding, sheet metal or machining.
• Lines	• identify and describe the types of lines commonly found on a drawing; e.g.: – object – hidden – centre line – dimension	
• Dimensions	• research dimensioning systems used to identify: – linear dimensions – angular dimensions – limits, fits and tolerance	
• Symbols	• identify the symbols used to describe: – types of materials – structural shapes – seams and joints – fabrication processes	Examine symbols used on electrical, plumbing, heating, machining and welding drawings.
	• read and interpret symbols denoting weld types and structural shapes	
• Fasteners	• identify the types of threaded fasteners and methods of representation; e.g.: – detailed – schematic	
	• identify the types of non-threaded fasteners and methods of representation; e.g.: – detailed – symbols.	
Planning and Management	• explain how prints are used to create a: – bill of materials – cutting list – schedule of operations.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Implementation • Print Reading	• match pictorial and orthographic drawings that have: – a surface parallel to the viewing plane – hidden edges or surfaces – inclined and oblique surfaces – curved surfaces and holes • read and interpret multiview prints to determine object sizes, shapes and fabrication specifications • read and interpret the size, type and location of threaded and non-threaded fasteners • prepare a list of materials and sequence of machine/tool operations from a given print.	
Assessment • Quality Control	• outline the importance of accurate prints and print reading skills to ensure high standards of quality and productivity	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2030: OXYFUEL WELDING

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1040 Oxyacetylene Welding

Module Description: Students develop basic skills in the safe and efficient use of oxyfuel equipment and supplies to braze and fusion weld.

Module Parameters: Access to a fabrication work centre complete with oxyfuel welding equipment and supplies and to instruction from an individual with formal, specialized training in oxyfuel welding practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the essential differences between braze welding and fusion welding	• an oral or written response that outlines the essential differences between braze welding and fusion welding	10
• demonstrate basic braze welding competencies	• completion of a series of braze weld applications in the flat and horizontal positions. *Assessment Tool* *Fabrication Process: Basic Oxyfuel Welding, FAB2030–1* *Standard* *Beads are to be slightly convex and of uniform width and height; ripples are to be evenly spaced and free of craters* *Performance rating of 2 for each applicable task*	30

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic oxyfuel weld (OFW) competencies in the flat, horizontal and vertical positions	• completion of light and heavy gauge fillet and square groove butt welds in the flat, horizontal and vertical positions. *Assessment Tool* *Fabrication Process: Basic Oxyfuel Welding, FAB2030–1* *Illustrative Example: Vertical Butt Joint Fusion Weld, FAB2030–2* *Standard* *Weld profile should be slightly convex and of uniform width and height; ripples are to be close, bullet shaped and free of voids, evidence of undercutting and overlapping. Good depth of penetration should be evident over the entire length of the weld* *Performance rating of 2 for each applicable task*	60
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any Assessment Tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• describe health and safety issues such as: – using the appropriate personal protective equipment and clothing – keeping the welding area free of combustible materials – insuring adequate ventilation particularly when braze welding – returning and storing all consumables as directed – locating appropriate fire extinguishers in the event of a fire	

MODULE FAB2030: OXYFUEL WELDING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Storage and Set Up of Oxygen and Fuel Cylinders	• describe the appropriate moving, storing and set-up procedures • identify local codes and restrictions related to the use and storage of oxygen and acetylene cylinders	Review WHMIS regulations regarding the safe storage and handling of oxyfuel cylinders.
• Oxyfuel Gases	• describe the alternative gases available for heating; their comparative temperatures and applications such as MAPP and propane	
• Welding Principles	• describe the differences between fusion welding and braze welding • list the advantages and disadvantages of braze welding.	Explain the difference between cohesive and adhesive bonding.
Planning and Management	• select the correct filler rod and tip size for a given application • set working gas pressures to match the tip size • describe the appropriate clearance allowed between parts of a braze weldment.	Review safe start-up and shut-down procedures.
Implementation		
• Oxyfuel Welding	• demonstrate basic skills in braze welding in the flat and horizontal positions • demonstrate basic fusion welding skills in the flat, vertical and horizontal positions.	Have students practise making a bead before attempting a braze weld. It is recommended that students practice flat butt joints before proceeding to the vertical and horizontal positions.
Assessment		
• Quality Control	• prepare a destructive and non-destructive weld assessment	
• Career Information	• research applications of oxyfuel welding	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2040: THERMAL CUTTING

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1040 Oxyacetylene Welding

Module Description: Students develop basic skills to use, safely and efficiently, thermal cutting equipment and supplies.

Module Parameters: Access to a fabrication work centre complete with thermal cutting equipment and to instruction from an individual with formal, specialized training in oxyfuel cutting practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards associated with thermal cutting, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance related to: – lab preparation – lab management – safe tool/material handling and storage	10
• perform safe start-up and shut-down cutting procedures	• demonstration of consistent safe start-up and shut-down procedures using oxyfuel, carbon arc and/or plasma arc equipment	20
• demonstrate basic manual cutting operations	• completion of uniform, straight, irregular and bevel cuts and pierced holes. *Assessment Tool* *Assessment Framework: Fabrication Process, FABPRS* *Standard* *Edges are to be square and drag lines are essentially vertical and not overly pronounced. There should not be evidence of gouging or excessive amounts of slag or dross* *Performance rating of 2 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• identify the workplace labels and precautionary procedures when using: – compressed gas – flammable materials – oxidizing materials – electrical equipment	
	• review a safety plan in case of accident	
• Thermal Cutting Characteristics of Ferrous and Nonferrous Metals	• describe common metals that can be successfully cut using: – oxyfuel – air carbon arc – shielded metal arc – plasma arc processes	
• Oxyfuel Cutting	• describe the oxyfuel process in relation to: – ignition temperature and identification – slag and oxide removal	Explain why oxyfuel cutting is limited to cutting ferrous materials.
	• identify the types of cutting fuels, their operating temperatures and efficiency ratios	
	• identify the parts of a cutting torch and their function	
	• describe the relationship between tip size, metal thickness and gas pressures	

Concept	Specific Learner Expectations	Notes
	The student should:	
- Oxyfuel Cutting (continued)	- describe the factors controlling tip selection; e.g.: – depth of cut – type of material – condition of metal – type and quality of cut - describe the correct way to start a cut and pierce a hole	
- Plasma Arc Cutting	- describe the plasma arc process in relation to: – arc formation – cutting gas – cooling – dross formation - identify and describe the purpose of the parts of a plasma arc cutting system - describe the appropriate method to: – start an arc – set standoff distance – control the kerf - list the advantages of using a plasma arc cutting system.	Explain why the plasma arc process can be used for cutting both ferrous and nonferrous materials. In addition to plasma arc cutting, demonstrate the use of carbon arc gouging equipment.
Planning and Management		
- Tool Selection and Adjustment	- select and adjust the appropriate equipment for a given cutting operation - describe correct start-up and shut-down procedures	
- Worker Safety	- locate the recommended fire extinguisher - locate and wear the appropriate personal protective equipment - locate and clear the workstation of all combustible materials.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Implementation		
• Oxyfuel	• demonstrate the use of oxyfuel equipment to cut: – straight edges and bevels – curves – holes in mild steel plate	Besides preparing materials for fabrication, metal cutting equipment is often used to create metal sculpture.
• Plasma Arc	• demonstrate the use of plasma arc to cut: – straight and curved cuts – holes in ferrous and non-ferrous metals	
• Carbon Arc Gouging	• demonstrate the safe use of carbon arc gouging equipment.	
Assessment		
• Quality Control	• inspect a cut and determine ways to improve the quality of the cut related to the size of the preheating flame, oxygen pressure, cutting speed and different machine settings, gas pressures and cutting speeds for plasma arc cutting	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2050: **ARC WELDING 1**

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1050 Basic Electric Welding

Module Description: Students develop basic knowledge, skills and attitudes related to the operation and use of shielded metal arc welding (SMAW) equipment and accessories to make a variety of welds in the flat position.

Module Parameters: Access to a fabrication work centre complete with shielded metal arc welding equipment and supplies and to instruction from an individual with formal, specialized training in arc welding practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify the appropriate treatment for minor injuries associated with welding processes	• the proper identification of first-aid treatment for minor cuts, burns and bruises	15
• describe the visual characteristics of a desirable weld	• identification and description of the important visual characteristics of a desirable weld	10
• demonstrate basic SMAW competencies in the flat position	• the completion of a series of stringer and/or weave beads in the flat position on a given weldment and two successive fillet and butt weld joints in the flat position. *Assessment Tool* *Fabrication Process: Basic Arc Welding, FAB2050–1* *Illustrative Example: Flat Lap Joint Fillet Weld, FAB2050–2* *Standard* *Weld profile should be slightly convex and of uniform width and height; ripples are to be close, bullet shaped and free of voids, slag inclusion, high spots and apparent restarts. Good plate penetration should exist over the entire length of the weld* *Performance rating of 2 for each applicable task*	75

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• First Aid	• demonstrate and describe the procedures for administering first aid for minor cuts, burns and bruises • explain the effects of arc flash and the suggested treatment • describe the effects of inadequate ventilation and the suggested treatment	Students need to have a good understanding of electrical terms and principles for their own safety and appreciation of how arc welding equipment operates.
• Electrical Fundamentals	• demonstrate knowledge of the following electrical terms: – direct current – alternating current – voltage – amperage – resistance – polarity – open circuit voltage and arc voltage	
• Arc Welding Equipment	• compare the operation and current output produced by a: – transformer – rectifier – generator • explain the meaning of duty cycle	Explain the difference between a constant current power supply used in SMAW and a constant voltage supply used on GMAW equipment.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Welding Accessories	• describe the construction and sizing of cables • compare the different types of electrode holders and maintenance requirements • identify the types and uses of cable lugs, quick connectors and work clamps.	
Planning and Management		
• Technique	• describe and demonstrate the accepted methods of striking an arc • describe the difference between a stringer bead and a weave bead • describe and demonstrate the proper tacking procedures and weld profile for a flat fillet weld	
• Equipment Set-up	• adjust the equipment to coincide with the type of electrode, type of weld and metal thickness	Students should have experience using different electrodes and diameters: • E6011 (41011) • E6010 (41010) • E7018 (48018) • E7024 (48024).
• Weld Quality	• identify the attributes of a quality weld.	
Implementation		
• Shielded Metal Arc Welding	• lay a consistent and even stringer bead and/or weave bead in the flat position • run a series of stringer beads in the flat position to create a layer of weld metal • make lap and square butt welds on mild steel plate in the flat position.	

MODULE FAB2050: ARC WELDING 1 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		
• Quality Control	• inspect a weld by considering the overall appearance, size and shape of the beads; plate penetration, fusion, undercutting and overlapping	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2060: ARC WELDING 2

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB2050 Arc Welding 1

Module Description: Students identify appropriate electrodes, visually assessing a weld, and making the necessary adjustments to improve weld quality while developing horizontal position welding skills.

Module Parameters: Access to a fabrication work centre complete with shielded metal arc welding equipment and supplies and to instruction from an individual with formal, specialized training in arc welding practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain the current systems used to classify electrodes in Canada and the United States	• accurate identification of the characteristics of three different electrodes using the Canadian Standards Association (CSA) and the American Welding Society (AWS) codes. *Assessment Tool* *Response Assessment: Electrode Coding, FAB2060–1* *Standard* *Response rating of 2*	10
• identify strategies to assess and improve weld quality	• assessment of a weld given a cross-section and plan view and strategies to correct observed faults to include: – use of the correct electrode – type of current and current settings – travel speed – electrode angle and inclination *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD*	15

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic shielded metal arc welding (SMAW) competencies in the horizontal position	• completion of two successive single and multiple pass fillet welds in the horizontal position using available mild steel plate. *Assessment Tool* *Fabrication Process: Horizontal Lap and Tee Joints, FAB2060–2* *Illustrative Example: Horizontal Tee Joint – Single Pass, FAB2060–3* *Standard* *Welds are to be the correct width and height, free of voids, slag inclusions and apparent restarts, undercutting or overlapping; plate surfaces and adjacent beads have adequate penetration and fusion* *Performance rating of 2 for each applicable task*	75
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation • Mild Steel Electrodes	• describe the purpose of the core wire and electrode coating • identify the characteristics of an electrode using AWS and CSA codes • show the relationship between metal thickness, electrode size and welding amperage	Explain the importance of using the correct electrode for a given application and the difference between the way electrodes are classified in the AWS and CSA systems; e.g., an E-7018 is the same as a 48018 electrode.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Arc Control	• compare straight and reverse polarity and the resultant heat distribution • describe the advantages and disadvantages of using alternating and direct current • identify the cause and corrective measures for arc blow • describe the effects of a short and long arc on mild steel	
• Weld Assessment	• describe the effects of improper: – amperage setting – arc length – travel speed	Explain the conditions that contribute to and prevent undercutting, overlapping, incorrect bead formation and lack of penetration.
• Joint Preparation	• explain the importance of removing: – oil – paint – rust – mill scale from a joint before welding.	
Planning and Management		
• Electrode Selection	• describe the electrode(s) that can be used for a given application by considering: – properties of the base metal – weld position – flux requirements – material thickness – static and dynamic load characteristics.	
Implementation		
• Shielded Metal Arc Welding	• use the appropriate electrode and machine setting to make single and multiple pass fillet in the horizontal position and groove welds in the flat position.	

Concept	Specific Learner Expectations	Notes
Assessment	*The student should:*	
• Quality Control	• inspect a weld by considering the overall appearance, size and shape of the beads, plate penetration, fusion and degree of undercutting and overlapping	Have students understand that stray arc marks and excessive spatter also detract from the quality of the weld.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2070: GAS METAL ARC WELDING 1

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1050 Basic Electric Welding

Module Description: Students build a knowledge and skill base related to gas metal arc welding (GMAW) that has both personal use and commercial applications.

Module Parameters: Access to a fabrication work centre complete with gas metal arc welding (GMAW) equipment and supplies and to instruction from an individual with formal, specialized training in arc welding practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• outline the advantages and disadvantages of gas metal arc welding versus other forms of arc welding processes	• written or oral presentation that outlines four advantages of GMAW over other forms of arc welding. *Assessment Tool* *Presentations/Reports: Advantages of Gas Metal Arc Welding, FAB2070–1* *Standard* *Performance rating of 2 for each applicable task*	15
• identify health and safety hazards associated with gas metal arc welding, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance related to: – appropriate selection and use of personal protective equipment – maintenance of a clean and tidy workstation – safe tool/material handling and storage.	10

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate gas metal arc welding competencies on light gauge mild steel in the flat and horizontal positions	*Assessment of student achievement should be based on:* • completion of light gauge fillet welds in the flat and horizontal positions. *Assessment Tool* *Fabrication Process: Light Gauge Fillet Welds, FAB2070–2* *Illustrative Example: Vertical Lap Joint Fillet Weld, FAB2070-3* *Standard* *Beads should be slightly convex, and of uniform width and height. Ripples are to be close, bullet shaped and free of voids, high spots, undercutting and coldlapping* *Performance rating of 2 for each applicable task*	75
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation • Health and Safety	• describe safety issues related to: – the appropriate use of personal protective equipment – handling and storing consumables – keeping the welding area free of hazards – insuring adequate ventilation • describe a safety plan in case of accident	

Concept	Specific Learner Expectations	Notes
	The student should:	
• Gas Metal Arc Welding (GMAW)	• describe the basic components and operating principles of GMAW • identify the purpose and types of shielding gases • list and describe the methods of metal transfer in GMAW; i.e., – short arc – globular – spray arc • describe the wire types in GMAW • identify different wire feeder types used in GMAW • identify and describe the different power supply used in GMAW • compare the advantage of GMAW over other arc welding processes.	Point out that the short arc process uses thinner wire, lower voltage and current than a spray arc process. Demonstrate the effects changes to voltage/amperage settings and selection of shielding gases have on weld quality.
Planning and Management • Equipment Set-up	• select the appropriate type and size of wire, feed rate, current, flow rate and shielded gas for a given type of weld and/or weldment • select the appropriate flux cored wire and machine settings • prepare and clean all surfaces to be welded.	Explain why the filler wire should have the same properties as the base metal.
Implementation	• make light gauge fillet welds in the flat and horizontal positions using GMAW and/or FCAW equipment.	
Assessment • Quality Control	• complete a visual inspection by considering the overall appearance, size and shape of beads, plate penetration, fusion and degree of undercutting and overlapping	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2090: SHEET FABRICATION 2 (MACHINE PROCESSES)

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1090 Sheet Fabrication 1 (Hand Processes)

Module Description: Students use basic layout, cutting, bending and fastening operations to transform common types of sheet metals into consumer products.

Module Parameters: Access to a fabrication work centre complete with basic sheet metal cutting, forming and fastening tools and to instruction from an individual with specialized training in sheet metal practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe common types of stock sheet metal materials and related tools	• accurate identification and description of five different sheet metal materials and 10 sheet metal machine tools	20
• demonstrate approved materials handling and storage practices	• observed performance related to: use of personal protective equipment – correct lifting techniques – measures taken to protect materials from surface damage – proper storage of cut-offs	10
• perform basic sheet metal fabrication skills and practices to produce a product	• successful completion of a given rectangular sheet metal product that uses one or more common seams and hems. *Assessment Tool* *Product Assessment: Basic Sheet Metal Products, FAB2090–1* *Standard* *The product should be structurally sound, free of surface defects and meet the stated size and shape specifications.* *Performance rating of 2 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Sheet Stock Identification and Handling	• identify common samples of sheet metal stock by their appearance and properties • describe the most appropriate way to safely handle and store metal stock • explain how sheet metal thicknesses are measured and stated	Point out that even though sheet metal work tends to be focused around a specific trade, the principles learned here have widespread applications.
• Cutting Sheet Stock	• explain the safe use of hand and machine tools to make internal and external: – straight cuts – curved cuts	
• Bending Sheet Stock	• explain the safe use of hand and machine tools to form a product	
• Seaming	• describe and give examples of uses for: – flange/butt – lap – folded – grooved seams	
• Riveting	• describe the advantages and disadvantages of: – tinner's rivets – pop rivets	
• Threaded Fasteners	• identify the common sizes and types of metal fastening screws and bolts	
• Soldering and Welding	• identify appropriate conditions and techniques to solder or weld a seam	

Concept	Specific Learner Expectations	Notes
- Finishing	*The student should:* - research common finishing techniques.	Suggested finishes include: – paint – powder spray – lacquer.
Planning and Management - Pattern Layout - Operation Sequencing	- calculate the appropriate hem and seam allowances for a given product - calculate and mark the sequence and direction of all bends.	
Implementation - Material Processing and Fabrication	- demonstrate basic sheet metal process and fabrication skills related to: – layout – cutting – bending – fastening procedures.	
Assessment - Quality Control - Career Preparation	- inspect a completed rectangular product for the overall attention to: – fit of seams – accuracy of measurement – structural soundness – quality of finish - prepare a record of completed activities within a portfolio.	

MODULE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE)

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB2090 Sheet Fabrication 2 (Machine Processes)

Module Description: Students expand sheet metal skills related to pattern making, seam constructing and edge treating.

Module Parameters: Access to a fabrication work centre complete with basic sheet forming and fastening tools and to instruction from an individual with specialized training in sheet metal practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe and give examples of parallel line developments	• correct description and identification of three sheet metal products that are made using parallel line developments	15
• create a parallel line development, using standard drawing and layout practices	• use of approved drawing practices to develop parallel line developments that can be used to produce products from light gauge sheet stock	25
• apply sheet metal fabrication principles skills to fabricate a product, using parallel line development	• the accurate layout and fabrication of a sheet metal product that uses one or more seams and edge treatments. *Assessment Tool* *Product Assessment: Parallel Line Developments, FAB2100–1* *Standard* *The product should be structurally sound and free of surface blemishes; seams and hems should be tight fitting and appropriate. Overall dimensions should meet design specifications* *Performance rating of 2 for each applicable task*	60

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• describe: – the use of appropriate personal protective equipment – proper storage of consumables – a safety plan in case of accident • explain how to provide adequate air quality for welding, soldering and finishing	
• Pattern Development	• list and describe the following pattern developments: – parallel line – radial line – triangulations	Provide examples of products that are developed through straight, parallel, radial line and triangulation.
• Pattern Types	• explain the use of: – full patterns – half patterns – pierced patterns	
• Hems and Edges	• identify and describe the purpose of a: – standing edge – single hem – double hem – wired edge • describe how to calculate the material allowance for a wire edge	

Concept	Specific Learner Expectations	Notes
	The student should:	
• Seams	• identify and describe the use of the following seams: – plain lap and flush lap – inside and outside lap – single and double seam – grooved joint – Pittsburgh lock	
• Shearing	• explain how and when to use: – combination, straight and aviation snips – notcher – squaring shears	
• Soft Soldering	• describe how to forge and tin solder coppers • select the appropriate flux for ferrous and nonferrous applications • explain how to sweat solder lap, single- and double-seamed joints	
• Other Fastening Techniques	• explain when it is appropriate to use: – spot welders – solid rivets – pop rivets.	
Planning and Management		
• Pattern Development	• calculate the material allowance for: – double and single seam – Pittsburgh lock • prepare a parallel line development	Students without a background in drafting may require extra assistance to prepare a pattern.
• Operation Sequencing	• create a systematic sequence of operations to fabricate a parallel line product.	
Implementation		
• Material Processing and Fabrication	• demonstrate basic sheet metal process and fabrication skills related to specific seam and edge treatments and fastening techniques.	Consider having students build a hinged tool box or carryall.

MODULE FAB2100: SHEET FABRICATION 3 (PARALLEL LINE) (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		
• Quality Control	• list criteria to assess a sheet metal product and apply it to the evaluation of a completed product	Consider such factors as product design, usefulness, durability and overall workmanship.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2110: FORGING FUNDAMENTALS

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1110 Bar & Tubular Fabrication

Module Description: Students determine the effects of heating and striking metal to change its shape and internal structure, using forging techniques.

Module Parameters: Access to a fabrication work centre complete with heating and forging equipment and to instruction from an individual with specialized training in forging practices.

Supporting Module: FAB1100 Fabrication Principles

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards associated with metal forging, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance in a typical work setting, related to: – appropriate selection and use of personal protective equipment – safe use of a forge and forging tools – maintenance of a clean and tidy workstation – safe handling and storage of tools and materials	10
• identify and describe the basic tools and processes used in forging	• accurate written or oral description of a forge; anvil and accessories; identification and description of drawing, tapering, bending, twisting and upsetting processes	20
• demonstrate basic metal forging skills and practices	• application of forging principles to shape a machine tool or other product. *Assessment Tool* *Product Assessment: Forge Work, FAB2110–1* *Standard* *The product is to be evenly shaped, finished and heat treated according to the stated specifications.* *Performance rating of 2 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Forging	• identify common and machine parts that are made by forging • compare the grain structure of a part shaped by forging with one shaped by casting or machining • identify and describe the types of hand tools that are used in forging	
• Hand Forging	• describe the use of: – hammers – tongs – sets – fullers – punches – swages • observe and note the processes of: – tapering – draw out – bending – twisting – upsetting	Hand forging is not widely practised in industry; however, the principles learned here are basic to all machine processes.

MODULE FAB2110: FORGING FUNDAMENTALS (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Heating	• describe the parts of a solid fuel or gas-fired forge • explain how temperatures are controlled • describe the chemical reactions that take place between the heating elements and the work piece • describe how the combination of heating and quenching can be used to control the shaping of the metal	Discuss the advantages and disadvantages of a gas-fired and solid fuel forge.
• Heat Treating	• describe the processes of hardening, tempering, annealing and normalizing related to forging	Heat treating concepts are further developed in Metallurgy Fundamentals (FAB3020).
• Drop Forging	• compare the process of drop forging with that of conventional forging techniques.	
Planning and Management		
• Health and Safety	• identify the appropriate personal protective equipment used in forging • describe the approved start-up and shut-down procedures for a given forge	
• Operation Schedule	• create a sequence of forging operations by analyzing an existing forged part or shop drawing.	
Implementation	• demonstrate basic forging skills using a variety of forging tools.	
Assessment		
• Career Information	• evaluate further local training and employment opportunities as a/an: – ornamental iron worker – farrier	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2120: FOUNDRY 2 (SPLIT PATTERN)

Level:	Intermediate
Theme:	Production Systems and Processes
Prerequisite:	FAB1120 Foundry 1 (One-piece Pattern)
Module Description:	Students expand their pattern making and foundry skills to produce split pattern molds and finished castings.
Module Parameters:	Access to a fabrication work centre complete with foundry equipment and supplies and to instruction from an individual with specialized training in foundry practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the essential similarities and differences between a one-piece pattern and a split pattern	• oral or written response that outlines the important similarities and differences between a one-piece pattern and mold and a split pattern and mold. *Assessment Tool* *Response Assessment: Split Pattern and Mold Making, FAB2120–1* *Standard* *Response rating of 2*	10
• describe and perform safe start-up and shut-down procedures for the operation of a foundry furnace	• demonstration of approved foundry furnace start-up and shut-down procedures and safe handling and pouring of molten metal	15
• demonstrate basic pattern making skills to make a split pattern	• successful completion of a simple split pattern. *Assessment Tool* *Product Assessment: Pattern Work and Mold Making, FAB2120–2* *Standard* *The pattern should incorporate the appropriate allowance for shrinkage and sufficient draft to allow for easy extraction.* *Performance rating of 2 for each applicable task*	40

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• apply sand casting principles and skills to make a casting from a split pattern	• successful completion of a mold and casting using a split pattern. *Assessment Tool* *Product Assessment: Pattern Work and Mold Making, FAB2120–2* *Standard* *The mold should be appropriately vented gated and rammed. The casting should be clean and free of voids; removal of gates should not distract from the overall appearance of the product* *Performance rating of 2 for each applicable task*	35
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation • Foundry Processes and Products	• from a selection of cast objects, list those made from two-part patterns and identify the "parting-line" on each casting	The same emphasis should be placed on pattern making as is placed on casting and finishing a product.
• Pattern Making	• describe the type of pattern used to make a mold for cylindrical/spherical objects • explain how a split pattern is aligned and why this is necessary • compare the shrinkage allowances for: – aluminium – brass – cast iron	

MODULE FAB2120: FOUNDRY 2 (SPLIT PATTERN) (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Mold Making	• describe the correct use of foundry tools and equipment to make a mold from a two-part pattern • explain how the two parts of the mold are aligned correctly	
• Foundry Furnaces	• list and describe common foundry furnaces and accessories • identify safe start-up and shut-down procedures for a given furnace.	Demonstrate how to safely start up and shut-down a foundry furnace.
Planning and Management		
• Heating and Pouring	• describe the correct pouring temperature for both aluminium alloy and lead-based alloys • identify appropriate fluxes to be used with the melting process	
• Health and Safety	• identify the dangers relating to: – handling ceramic crucibles – moisture in contact with molten metal – metals splashing – molds incorrectly vented – metal escape if mating flask surfaces are damaged – water as a sand binder – fumes from metal, fluxing and binders – common foundry practices to avoid injury in all of the above • describe a safety plan in case of accident.	

MODULE FAB2120: FOUNDRY 2 (SPLIT PATTERN) (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Implementation • Material Processing	• use the appropriate tools, materials and processes to: – construct a split pattern – create a sand mold – pour – cool – remove flash, gates and runners – finish a sand casting.	
Assessment • Quality Control	• identify the cause of porosity in a casting and take appropriate measures to correct the problem	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2130: PRECISION TURNING 1

Level: Intermediate

Theme: Production Systems and Processes

Prerequisite: FAB1130 Principles of Machining

Module Description: Students develop basic turning skills to size, shape and finish common machineable metals and plastics.

Module Parameters Access to a fabrication work centre complete with mctal lathe and accessories and to instruction from an individual with specialized training in machining practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards specific to metal turning, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance related to: – appropriate selection and use of personal protective equipment – containment of long hair, loose clothing, removal of rings and other forms of jewellery – safe handling of materials – precautions taken to ensure the safety of others	10
• perform safe metal lathe set-up, operation and shut-down procedures	• demonstration of approved practices to: – mount work in a three- or four-jaw chuck – mount work using a chuck and a live or dead centre – mount work between centres – set-up for a taper. *Assessment Tools* *Equipment Checklist: Metal Lathe FABEQUIP–3* *Standard* *All procedures to be performed correctly*	15

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic straight turning and finishing skills	• completion of the following machining operations: – face stock in a three- or four-jaw chuck – drill centre holes – turn work in a three- or four-jaw chuck – turn work between centres – knurl and finish. *Assessment Tool* *Fabrication Process: Straight Turning, FAB2130-1* *Illustrative Example: Screwdriver, FAB2130–2* *Standard* *Dimensions and levels of finish are to be within stated tolerances and specifications* *Performance rating of 2 for each applicable task*	75
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• describe safety procedures related to the use and operation of metal turning equipment • identify and correct common hazards related to machine lathe and turning processes • describe a safety plan in case of accident	Review the operation of a metal lathe, identify accessories and point out how a lathe is sized by the length of its bed and swing.
• Machining Characteristics	• compare the machining characteristics of common ferrous and non-ferrous materials	Explain how these characteristics affect the choice of cutting tool, spindle speeds and feed rates.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Lathe Parts and Accessories	• describe the basic parts and accessories of an engine lathe • explain the difference between a three- and a four-jaw chuck • identify cutting and forming tools that are used for: – roughing – facing – drilling – boring – parting – knurling – finishing	
• Machine Operations	• describe the correct procedures to: – mount work in a three- and/or four-jaw chuck – mount work between centres • describe set-up procedures to face, centre drill, straight turn and drill stock • describe the factors that affect spindle speed, feed rate and depth of cut • describe safe finishing techniques, using files and abrasives • identify and describe lathe and lathe tool lubricants and coolants.	Demonstrate how to centre an object in a four-jaw chuck and how to select and centre a cutting tool.

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Print Reading	• from a machine drawing of a turned part, identify: – overall dimension – types of material – types of finishes – fits and tolerances	Compare the use and accuracy of mechanical and electronic measuring devices such as a vernier and digital caliper.
	• list and describe the machining operations in a logical order	
	• calculate the appropriate cutting speeds, feed rates and depth of cuts for rough turning, finishing, drilling and knurling different materials.	Use appropriate tables and charts.
Implementation		
• Lathe Work	• demonstrate basic turning skills related to: – facing – centre drilling – straight turning – drilling – boring – knurling – parting – finishing common machineable metals and/or plastics.	The fabrication of products, such as a mallet and screwdriver handle, provide opportunities for the student to develop a wide range of lathe skills.
Assessment		
• Quality Control	• research ways to improve output quality and reduce machining time	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2140: PRECISION MILLING 1

Level: Intermediate

Theme: Production Systems and Processes

Prerequisite: FAB1130 Principles of Machining

Module Description: Students develop basic milling skills to shape and finish common machineable metals and plastics.

Module Parameters Access to a fabrication work centre complete with vertical and/or horizontal mill and accessories and to instruction from an individual with specialized training in machining practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards specific to milling operations, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance related to: – appropriate selection and use of personal protective equipment – containment of long hair, loose clothing, removal of rings and other forms of jewellery – safe handling of materials – keeping a clean and orderly work area	10
• perform safe milling machine set-up, operation and shut-down procedures	• demonstration of approved practices related to the safe set-up of a vertical and/or horizontal mill. *Assessment Tool* *Equipment Checklist: Milling Machines, FABEQUIP–4* *Standard* *All procedures to be performed correctly*	15

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate basic milling machine skills and practices	• completion of a milled part that incorporates square and bevelled surfaces using a vertical and/or horizontal mill. *Assessment Tool* *Fabrication Process: Mill Work, FAB2140–1* *Illustrative Example: Aluminum Dice, FAB2140–2* *Standard* *Dimensions and quality of finish are to be within stated tolerances and specifications* *Performance rating of 2 for each applicable task*	75
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• observe all safety procedures related to the use and operation of metal milling equipment • describe a safety plan in case of accident	
• Mill Parts and Accessories	• identify and describe the basic parts and accessories of a milling machine • compare the operation and uses of a vertical mill to a horizontal mill • identify and describe the types of cutters used in vertical and horizontal milling according to their size, construction and purpose; e.g.: – plain milling – side milling – end milling cutters	Describe the two basic types of milling machines and the types of surfaces and features they are able to produce.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Lubricants and Cutting Fluids	• use the recommended lubricants for a given milling machine • identify the purpose of a cutting fluid and identify common types	Refer to product labels and instructions for proper use and handling.
• Machine Operation	• research typical set-up procedures for horizontal and/or vertical milling to create flat surfaces, grooves and chamfers • identify the factors that determine cutting speeds, feed rates and depths of cuts • explain the advantages and disadvantages of upcutting and climb milling.	Do not attempt climb milling without backlash eliminators.
Planning and Management		
• Print Reading	• identify from a machine drawing of a milled part, the: – overall dimensions and tolerance – quality of surface finish – most appropriate milling machine and cutters to be used	
• Squaring Operations	• list and describe the machining operations to square stock, bevel and chamfer surfaces • calculate the appropriate cutting speeds, feed rates and depth of cuts for a specific operation.	
Implementation		
• Milling	• demonstrate basic competencies using a milling machine to rough size, square, bevel, chamfer and finish machine parts to the prescribed tolerances and specification.	
Assessment		
• Quality Control	• research ways to improve output quality and machining time	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB2150: CNC TURNING (COMPUTER NUMERICAL CONTROL)

Level: Intermediate

Theme: Production Systems and Processes

Prerequisite: FAB1130 Principles of Machining

Module Description: Students develop skills in computer assisted design (CAD) and computer numerical control (CNC) programming to manufacture a product on a CNC lathe.

Module Parameters: Access to a fabrication work centre complete with CNC turning centre and to instruction from an individual with specialized training in CNC practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify safety hazards associated with CNC equipment and, take preventive measures to avoid accidents and personal injury to self and others	• ongoing observation related to: – appropriate selection and use of personal protective equipment – use of safety covers and guards – use of dry runs	10
• demonstrate two dimensional programming and/or CAD skills	• development of a 2-D program to produce a machineable part on a CNC lathe using absolute coordinates and/or CAD file conversion	60
• apply CNC programming skills to manufacture a turned part	• performing the appropriate set-up testing and running procedures to produce a turned part. *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD* *Standard* *Product is to be within stated machine tolerances.* *Performance rating of 2 for each applicable task*	30

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Lathe Operation	• describe the principles of machining and the operation of a metal lathe	Demonstrate the proper set-up and operation of a CNC lathe.
	• analyze a CNC lathe and describe how turning speeds and feed rates are controlled; tools and work pieces are mounted	
	• identify the turning capabilities of a lathe; e.g.: – types of materials – set-ups – cutting tools	More and more industries are using computer-controlled equipment. Students who enter the machining field will require a knowledge of basic programming principles.
	• describe the safety features that are built into the CNC equipment	
• Programming	• identify the relationship of the x and y axis on a metal lathe	Use the Cartesian system to describe a point.
	• explain how to program a lathe using absolute coordinates	
• Dimensioning Systems	• compare the advantages of using incremental and absolute systems of measurements	
	• explain the difference between using a fixed zero and full floating zero	
• G and M Codes	• describe the purpose of G and M codes	
	• explain how canned cycles are used in programming	

Concept	Specific Learner Expectations	Notes
• CAD/CAM	*The student should:* • explain how a CAD file can be converted to a machineable part file.	
Planning and Management • Health and Safety	• describe the: – appropriate use of protective equipment and clothing – need to keep work area clean and free of hazards – importance of following the manufacturer's instructions and keeping all guards in place in working order • describe a safety plan in case of accident	
• 2-D Programming	• prepare a program from a print using absolute coordinates and/or produce a CAD design • simulate the tool path using computer graphics.	
Implementation • Production	• load the program or convert a CAD file • mount and secure the workpiece • identify reference and clearance points • mount and set cutting tool(s) • complete a test run • manufacture the part.	
Assessment • Quality Control	• inspect the part to see that it meets the print dimensions, tolerances and specifications	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB2160: CUSTOM FABRICATION

Level: Intermediate

Theme: Production Systems and Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students work independently, or in a cooperative learning environment, to plan and construct a product/structure that meets a specific client's needs.

Parameters: Access to fabrication facilities and equipment, and to instruction from an individual with trade qualifications if students are involved in customer work related to welding and other trade-related activities.

Supporting Course: FAB1160 Production Systems

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate appropriate communicating and planning skills	• observed communication with a client that includes: – methods used to determine the customer needs – a design proposal and approval – cost and time estimate – contract terms	25
• demonstrate effective resource management skills and practices	• applied resource management skills used to access and deploy human and material resources	25
• demonstrate custom fabrication competencies	• successful fabrication of a custom product that fulfills the conditions of the contract. *Assessment Tool* *Product Assessment: Custom Work, FAB2160–1* *Standard* *Performance rating of 2 for each applicable task*	50
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

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Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Custom Manufacturing	• describe the advantages and disadvantages of custom production	Encourage students to work with a client to determine his or her product needs, develop a proposal and complete a project to satisfy the customer rather than simply build a project for themselves.
• Client Needs	• list the steps to follow in determining a customer's needs	
• Management Skills	• identify and describe key management elements, such as: – organizing – designing – producing – controlling.	
Planning and Management		
• Customer Interface	• identify the product/structure specifications through consultation with the customer • create a suitable design, timeline and budget by working collaboratively with the customer • explain to the customer any need to make changes • change orders as the customer sees necessary • complete a customer satisfaction follow-up	
• Construction and Fabrication Planning	• identify the types and properties of the materials to be used • explain whether any specialized equipment will be needed to complete the task • evaluate the need to construct special jigs or fixtures • describe any unique finishing and installation requirements.	

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MODULE FAB2160: CUSTOM FABRICATION (continued)

Concept	Specific Learner Expectations	Notes
• Cooperative Work Strategies	*The student should:* • explain the need to: – identify group and individual responsibilities – identify and capitalize on individual strengths – participate in group as well as self-evaluative processes – develop strategies for positive criticism.	
Implementation • Construction and Fabrication	• complete responsibilities to: – break out materials according to a prearranged plan – process materials with a minimum number of set ups – assemble, finish and prepare the product/ structure for delivery or installation.	
Assessment • Follow-up • Career Preparation	• research ways to determine customer satisfaction • identify future service requirements • explain a method for gaining new leads • prepare a record of completed activities within a portfolio.	

COURSE FAB2170: **PIPE FITTING**

Level: Intermediate

Theme: Fabrication Processes

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students learn about the uses of pipes, basic piping principles and fabrication skills.

Parameters: Access to a fabrication work centre complete with cutting, threading and assembly tools, and to instruction from an individual with specialized training in pipe cutting and fitting practices.

Supporting Course: FAB1110 Bar & Tubular Fabrication

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe common pipe fitting materials and applications	• accurate identification and description of four different pipe materials and appropriate applications	25
• research and profile a trade or occupation within the pipe fitting field	• presentation of a career profile that outlines: – present and future career opportunities – skill requirements – training opportunities. *Assessment Tool* *Research Process: Piping Systems, FAB2170–1* *Standard* *Performance rating of 2 for each applicable task*	15
• demonstrate approved methods of joining common types of pipes and materials	• completion of a simple piping system that incorporates a variety of pipe materials, fittings and components. *Assessment Tool* *Assessment Framework: Activity Assessment, FABACT* *Standard* *The system should be accurately laid out and connected with tight joints. Overall workmanship should meet trade expectations* *Performance rating of 2 for each applicable task*	60

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COURSE FAB2170: PIPE FITTING (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Piping Systems	• research and describe the types of piping systems used to provide: – gas supply systems – sprinkler systems – hot water and heating services – steam and superheated steam – cooling systems – petroleum and chemical products	Discuss residential and commercial applications of piping systems.
• Pipe Materials	• identify and provide applications for: – standard pipe (black and galvanized) – thin wall pipe – extra strong (xs) pipe • research and give examples of how common piping materials are coded and specified	
• Pipe Components	• list and describe components found in piping systems; e.g.: – flanges and fittings – valves – traps – pumps	
• Joining Pipes	• describe appropriate applications and methods of joining pipe, by: – threading – welding – mechanical fasteners.	

MODULE FAB2170: PIPE FITTING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Joining Pipes (continued)	• describe how to join dissimilar pipe materials; e.g.: – steel pipe to copper – steel pipe to plastic	
• Calculations and Layout	• analyze various methods to measure pipe lengths and calculate offsets • identify appropriate methods of laying, hanging and securing pipe.	
Planning and Management		
• Print Reading	• describe the appropriate type and size of pipe, fittings and components for a given drawing • calculate the length of a given offset.	
Implementation		
• Health and Safety	• identify all safety procedures related to: – use of personal protective clothing – lifting heavy weights – use of ladders and scaffolds – use of tools and materials • describe a safety plan in case of accident	Students may have to go off campus to gain practical experience in this module.
• Pipe Fabrication	• use the appropriate tools to make a small pipe assembly that incorporates a variety of fittings and components.	
Assessment		
• Quality Control	• test a simple pipe assembly for: – accuracy – tightness of joints – overall workmanship	
• Career Information	• research career and further training opportunities related to pipe work • evaluate personal interests and abilities related to making realistic career choices	

Concept	Specific Learner Expectations	Notes
	The student should:	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE CURRICULUM AND ASSESSMENT STANDARDS:

SECTION F: ADVANCED LEVEL

The following pages define the curriculum and assessment standards for the advanced level of Fabrication Studies.

Advanced level modules demand a higher level of expertise and help prepare students for entry into the workplace or a related post-secondary program.

Module FAB3010: Materials Testing F.3
Module FAB3020: Metallurgy Fundamentals F.7
Module FAB3030: Gas Tungsten Arc Welding........ F.13
Module FAB3040: Specialized Welding F.17
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Module FAB3170: Gas Metal Arc Welding 2 .... F.65

COURSE FAB3010: MATERIALS TESTING

Level: Advanced

Theme: Materials and Structures

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students are introduced to the principles of materials testing, and to the development and evaluation of a mechanical materials test.

Parameters: Access to common hand and power assisted tools, and to instruction from an individual with specialized training in material testing.

Supporting Courses: FAB1100 Fabrication Principles
DES1020 The Design Process [Design Studies Strand]

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the purpose and nature of materials testing	• the description of two or more different types of materials tests and testing procedures	20
• apply testing principles to construct or use a piece of materials testing apparatus	• identification and development of a piece of test apparatus	50
• test and compare the properties of common materials used in construction and fabrication	• results of a test on three different materials. *Assessment Tool* *Lab Investigations: Testing Materials, FAB3010–1* *Standard* *The apparatus is to be safe, easily used and calibrated: results should be consistent with other forms of testing equipment. Results should be effectively communicated and be consistent with current findings* *Performance rating of 3 for each applicable task*	30
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

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COURSE FAB3010: MATERIALS TESTING (continued)

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Types of Tests	• identify and describe common methods of testing materials; e.g.: – non-destructive – destructive	Discuss the use of non-destructive tests, such as: – magnetic particles – liquid dye – X-ray – ultrasonic. Describe methods of testing for: – hardness – tensile strength – ductility – metal fatigue.
• Testing Results	• explain how test results are recorded and communicate a plan showing how to anticipate the results of a test	Explain why material testing is important.
• Health and Safety	• identify common hazards associated with the use of a specific tool, material and/or process • identify and correct potential hazards within the working environment • describe a safety plan in case of an accident.	
Planning and Management		
• Test Equipment	• design a piece of testing apparatus or test procedure • create safety controls • construct testing devices *or* • analyze an existing piece of test equipment and describe its: – purpose – operation – method of calibration and data recovery • identify type of test, calibration and data recovery	Have students design and build a piece of test apparatus that can be used to test a particular material property, such as shear strength, torsion, hardness and impact.
• Complete Tests	• prepare the materials as required.	

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Concept	Specific Learner Expectations	Notes
	The student should:	
Implementation • Testing	• conduct a given test on a variety of materials and record the test results.	
Assessment • Quality Control/ Reliability	• compare the data obtained from the materials tested to anticipated results • explain the reliability of the testing procedure • identify the advantages/disadvantages of test being carried out	Students should be encouraged to visit a test lab either in industry or in a post-secondary institution.
• Career Information	• identify further training and career opportunities related to material testing	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

COURSE FAB3020: METALLURGY FUNDAMENTALS

Level: Advanced

Theme: Materials and Structures

Prerequisite: FAB1010 Fabrication Tools & Materials

Description: Students develop fundamental understandings and skills related to metallurgy, and apply these skills to fabrication processes.

Parameters: Access to a fabrication work centre complete with heat treating equipment, and to instruction from an individual with specialized training in heat treating practices.

Supporting Course: FAB3010 Materials Testing

Curriculum and Assessment Standards

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify and describe the fundamental principles of metallurgy and their industrial applications	• presentation of a written report that identifies and describes how the principles of metallurgy are applied to improve the quality of a given product	20
• identify the basic alloy components and properties of common alloys	• a description of the major alloy elements and properties of four common alloys. *Assessment Tool* *Presentations/Reports, CTSPRE* *Standard* *Performance rating of 3 for each applicable task*	20
• apply metallurgical principles, skills and processes to heat treat a component or product	• successful production or repair of a product that requires one or more heat treating process. *Assessment Tool* *Assessment Framework: Activity Assessment, FABACT* *Standard* *An acceptable repair or product that has the characteristics of hardness and toughness as specified in the design specifications* *Performance rating of 3 for each applicable task*	60

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COURSE FAB3020: METALLURGY FUNDAMENTALS (continued)

General Outcomes	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Outcomes	Notes
	The student should:	
Orientation		
• Metallurgy	• list and describe the three major fields of metallurgy; i.e., – extractive – mechanical – physical metallurgy	Having a good understanding of the basic principles of metallurgy is important for every serious metals student.
• Metallic Structures	• use the following terms to describe the internal structure of metals; e.g.: – atomic structure – compound – solution – crystal	
• Metallurgy Application	• explain how the principles of metallurgy are used in: – welding – foundry – mechanically forming and finishing metals	Student should understand that temperature, time and stress affect the properties of metals.
	• explain the relationship between the properties of a metal and its structure	The structure of a metal can be modified by altering its chemical composition alloying and heat treating.

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Concept	Specific Learner Expectations	Notes
	The student should:	
• Metallurgy Application (continued)	• describe the effects of cooling on the size and shape of a crystal	Have students understand that a casting made in a metal mold would likely have a different structure to one made in a sand mold because of the different rates of cooling.
• Alloying	• identify elements that are dissolved together to form common alloys such as: – steel – bronze – brass – aluminum alloy	
	• describe the effects of adding greater or lesser percentages of carbon to the strength, hardness and brittleness of steel	Note that atoms of other elements often distort the arrangements of the crystals, which changes the characteristics of the metal.
	• identify the basic alloy components and common uses of the following steel types: – carbon steels – alloy steels – tool steels – stainless steels	
• Metal Identification	• describe common methods of identifying ferrous and nonferrous materials such as spark, magnetic and specific gravity tests	
• Corrosion	• describe the electrochemical nature of corrosion	
	• identify common methods of reducing corrosion; e.g.: – protective coating – oxide layers – alloys	Students should understand that corrosion is more likely to occur in areas where a structure is under stress and in contact with water.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Heat Treating	• compare the effects of heating and cooling on steels with varying carbon contents • describe the process and purpose of: – quenching – normalizing – annealing – tempering – surface hardening • explain how heat treating principles are applied to welding and other fabrication processes	Because of the rapid rate of heat removed adjacent to a weld, the welding process can often change the properties of the metal in this region.
• Work Hardening	• explain how cold working differs from heat treating.	
Planning and Management • Heat Treating	• determine the procedures and critical temperatures to heat treat one or more of the following tools: – wood chisel – screw driver – center punch – cold chisel • describe the safe start-up and shut-down procedures of a heat treating furnace.	
Implementation • Material Fabrication	• use the appropriate materials processes and tools to fabricate and condition a new product or make repairs to an existing product.	Simple products that require heat treating include: – centre punch – cold chisel – drift – hammer head.

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		A visit to a foundry or a manufacturing plant that produces springs and other machine parts would be helpful.
• Quality Control	• research ways to test a product for hardness and toughness	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3030: GAS TUNGSTEN ARC WELDING

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2030 Oxyfuel Welding

Module Description: Students develop basic knowledge and skills related to the use of gas tungsten arc welding (GTAW) equipment and supplies to weld mild steel in the flat and horizontal positions.

Module Parameters: Access to a welding facility complete with gas tungsten arc welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Supporting Module: FAB2060 Arc Welding 2
FAB2070 Gas Metal Arc Welding 1

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards associated with GTAW, and take preventive measures to avoid accidents and personal injury to self and others	• observed performance related to: – appropriate selection and use of personal protective equipment – safe use of equipment and supplies – measures taken to ensure the safety of others	15
• outline the advantages of GTAW over other forms of welding	• written or oral presentation that outlines four advantages of gas tungsten arc welding	15
• demonstrate basic GTAW competencies in the flat and horizontal positions	• completion of mild steel fillet and groove welds in the flat, horizontal and vertical positions. *Assessment Tool* *Fabrication Process: Tungsten Arc Welding, FAB3030–1* *Standard* *Welds should be clean and bright, with ripples that are uniformly formed and free of craters; penetration should be even throughout the weld.* *Competency level of 3*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Occupational Health and Safety	• identify and describe the health and safety issues associated with GTAW such as: – electric current – inert gases – arc radiation – ventilation	This module requires specialized equipment. Students who wish to get credit in this module may need to access this equipment in an off-campus environment.
	• describe a safety plan in case of accident	
• Gas Tungsten Arc Welding	• describe the basic components and operating principles of GTAW • identify the advantages of GTAW over other forms of arc welding	
• Power Supply	• describe the major types of power supplies and current outputs; e.g.: – high frequency current – alternating current (AC) – direct current straight polarity (DCSP) – direct current reverse polarity (DCRP) • identify the appropriate type of current used for welding: – low carbon steel – aluminium – stainless steel	

MODULE FAB3030: GAS TUNGSTEN ARC WELDING (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
• Shielding Gases	• explain the purpose of a shielding gas • identify the appropriate type of gas to be used with: – low carbon steel – aluminium – stainless steel	
• Electrodes	• select, prepare and install the appropriate electrode for: – AC – DCSP or DCEN – DCRP or DCEP welding	
• Filler Metal	• demonstrate proper handling techniques to prevent weld contamination • identify the degreasers that are commonly used to clean filler materials.	
Planning and Management		
• Start-up and Shut-down	• identify and demonstrate the appropriate start-up and shut-down procedures for welding mild steel	
• Technique	• demonstrate typical methods used to start an arc • describe the correct torch angle for a lap and groove weld in the flat, horizontal and vertical positions	
• Weld Preparation	• show that mill scale, rust, paint and oil has been removed from the weldments	To avoid weld contamination, stress the importance of having clean surfaces.
• Standards	• list the characteristics of a weld that meets trade standards.	
Implementation		
• Gas Tungsten Arc Welding	• make lap and groove welds in the flat, horizontal and vertical positions.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		
• Quality Control	• perform a visual inspection of a weld and describe its characteristics	Welds should be clean and bright, have uniform beads and even penetration.
• Career Information	• identify career opportunities related to GTAW	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3040: **SPECIALIZED WELDING**

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2030 Oxyfuel Welding

Module Description: Students develop specific skills associated with advanced welding techniques to join and repair metals other than low carbon steel.

Module Parameters: Access to a welding facility complete with advanced level welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Supporting Modules:
FAB3030 Gas Tungsten Arc Welding
FAB3050 Arc Welding 3
FAB3170 Gas Metal Arc Welding 2

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• list health and safety specific hazards associated with welding metals other than low carbon steels, and take preventive measures to avoid accidents and personal injury to self and others	• identification of the hazards associated with welding metals containing zinc, cadmium, lead, tin and chromium	10
• describe the unique welding characteristics of weldable metals other than low carbon steel	• a description of the characteristics and methods of welding aluminium, stainless steel and cast iron	20
• select appropriate filler material and welding process to weld a metal other than low carbon steel	• performing a given weld on any one or more of the following materials: – aluminium – stainless steel – cast iron. *Assessment Tool* *Assessment Framework: Fabrication Process, FABPRS* *Standard* *Performance rating of 3 for each applicable task*	70

MODULE FAB3040: SPECIALIZED WELDING (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation • Health and Safety	• describe the health hazards connected with welding metals containing zinc, cadmium, lead, tin and chromium • describe a safety plan in case of accident	
• Welding Parameters	• research and describe the unique welding characteristics of: – stainless steel – cast iron – aluminium – white metal (zinc die cast metal).	Explain why it is often difficult to weld these materials.
Planning and Management	• identify a suitable filler metal and flux to join or repair: – stainless steel – cast iron – aluminium – white metal • identify the appropriate joint preparation, supports and techniques for a given metal.	
Implementation • Welding Process	• perform a weld or repair on one or more metals other than a low carbon steel.	

MODULE FAB3040: SPECIALIZED WELDING (continued)

Concept	Specific Learner Expectations	Notes
Assessment	*The student should:*	
• Quality Control	• complete a visual inspection by considering the overall appearance, size and shape of the beads and degree of penetration	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3050: ARC WELDING 3

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2060 Arc Welding 2

Module Description: Students learn the role of codes and standards in the welding trade, as well as test welds and develop vertical position welding skills.

Module Parameters: Access to a welding facility complete with shielded metal arc welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• examine and maintain sheet metal arc welding (SMAW) equipment and accessories	• observed performance related to the examination and maintenance of personal protective equipment, welding accessories and equipment	15
• read and interpret weld drawings and symbols	• accurate reading of a welding symbol that graphically represents three details such as the type of weld, its location and process	15
• demonstrate advanced level SMAW competencies in the vertical position	• completion of two successive single and multiple pass fillet vee-groove and outside corner welds in the vertical position on mild steel plate. *Assessment Tool* *Fabrication Process: Vertical Lap and Tee Joints, FAB3050–1* *Illustrative Example: Vertical Outside Corner – Multi-pass, FAB3050–2* *Standard* *Welds are to be the correct width and height, free of voids, slag inclusions and apparent restarts, undercutting or overlapping; plate surfaces and adjacent beads have adequate penetration and fusion.* *Performance rating of 3 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Welding Codes, Standards and Specifications	• explain the purpose of welding: – codes – standards – specifications	Stress the importance of safety and weld quality and explain how codes and standards help achieve this end.
	• identify agencies that establish codes and standards in Canada and the United States; e.g.: – Canadian Standards Association (CSA) – American Welding Society (AWS) – Canadian Welding Bureau (CWB) – American Society of Mechanical Engineers	
• Welding Symbols	• explain the purpose of a weld symbol • identify the basic data included in a welding symbol	
	• show how a welding symbol can be used to specify: – location of a weld – type of weld – welding process – root opening – contour – degree of penetration – type of electrode	Point out that a welding symbol can communicate a great deal of information in a small space and therefore must be fully understood.

Concept	Specific Learner Expectations	Notes
• Testing	*The student should:* • analyze common destructive and non-destructive testing methods.	
Planning and Management		
• Care and Maintenance of Equipment	• before beginning to weld: – analyze the condition of cables and lugs – insure adequate air flow for proper cooling – check the condition of all personal protective equipment	
• Print Reading	• use a welding symbol to determine: – location of a weld – type of weld – root opening – type of electrode.	This module has a strong link to FAB2020: Print Reading.
Implementation		
• Shielded Metal Arc Welding	• use the appropriate equipment and supplies to make single and multiple pass fillet and vee-groove welds in the vertical position.	E6010, E6011 and E7018 electrodes are recommended for this activity.
Assessment		
• Quality Control	• perform one or more destructive and non-destructive tests on a weld sample	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3060: ARC WELDING 4

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB3050 Arc Welding 3

Module Description: Students apply and extend positional welding skills, by using a variety of common electrodes and thickness of materials.

Module Parameters: Access to a welding facility complete with shielded metal arc welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain the effects heating and cooling have on a weld and weldment	• the description of the effects heating and cooling have on the quality of a weld and the adjacent materials	10
• demonstrate advanced level sheet metal arc welding (SMAW) competencies in the flat, horizontal and vertical positions	• completion of a variety of welds to first period trade standards using different electrodes and thicknesses of materials. *Assessment Tool* *Fabrication Process, Butt Joint Welds, FAB3060–1* *Illustrative Example: Flat Vee-groove Butt Joint, FAB3060–2* *Standard* *Performance rating of 3 for each applicable task*	70
• describe a career related to the welding field	• presentation of one occupational profile that outlines: – description of the occupation/trade working conditions – employment opportunities – training requirements. *Assessment Tool* *Assessment Framework: Presentations/Reports, CTSPRE* *Standard* *Performance rating of 3 for each applicable task*	20

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Heating and Cooling	• describe the effect of single and multiple pass welds on the base metal and previously deposited filler metal • explain the effect cold working conditions might have on weld quality • explain the need to preheat or postheat	
• Electrode Selection	• describe the factors to be considered when choosing an electrode; e.g.: – static and dynamic loading – weld position – materials to be welded – current supply – ease of use – joint design and alignment – rate of deposit – depth of penetration – weld finish.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Preparation	• describe the properties and uses of the following electrodes: – E6010 and 11 – E7014, 18 and 24 • select the appropriate electrode for a given application • prepare the surfaces for welding • correctly position the weld	
• Equipment Set-up	• adjust the equipment to coincide with the type of electrode, weld and metal thickness.	
Implementation		
• Shielded Metal Arc Welding	• demonstrate first period arc welding skills in the flat, horizontal and vertical positions using a variety of weld types, joints, electrodes and thickness of mild steel • prepare welds for testing.	Welds completed here should be similar to those found in the first period of the apprenticeship program.
Assessment		
• Quality Control	• perform a non-destructive and destructive test where appropriate	At this level, most faults can be detected through visual inspection.
• Career Preparation	• describe employment opportunities and further training requirements for the welding trade or related occupation • evaluate personal interests and abilities related to making realistic career choices • prepare a record of completed activities within a portfolio.	

MODULE FAB3070: PIPE & TUBULAR WELDING

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB3170 Gas Metal Arc Welding 2

Module Description: Students develop specific skills related to pipe layout, preparation of pipe/tube joints and welding techniques.

Modular Parameters: Access to a welding facility complete with welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Supporting Module:
FAB2040 Thermal Cutting
FAB2060 Arc Welding 2
FAB3050 Arc Welding 3

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify health and safety hazards associated with pipe and enclosed vessel welding, and take preventive measures to avoid accident and personal injury to self and others	• observed performance related to: – appropriate selection and use of personal protective equipment – preparation and selection of equipment and supplies – measures taken to ensure the safety of others	10
• describe the advances made in pipe welding, and identify common types of joints and welding procedures	• identification and description of common pipe joints, welding procedures and advantages of welded joints over other forms of joining pipe together	20
• demonstrate basic pipe/tube preparation and welding competencies	• accurate lay out, preparation and completion of a butt, tee and lateral pipe/tubular weld joint using roll and/or positional welding techniques. *Assessment Tool* *Fabrication Process: Joint Preparation and Welding, FAB3070-1* *Standard* *Performance rating of 3 for each applicable task.*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Orientation • Pipe and Tube Welding	*The student should:* • list the advantages of welding over other forms of joining pipe related to: – strength – required maintenance – flow of liquids and gases – weight of joint • identify the standards of certification required for welding: – low pressure water lines or light structural application – medium pressure residential gas lines – high pressure gas lines, motor cycle and aircraft frames.	
Planning and Management • Health and Safety	• identify the precautions that must be taken prior to cutting or welding pipe or other enclosed vessel – review a safety plan in case of accident	Stress the importance of knowing what a pipe/vessel has been used for prior to welding.

Concept	Specific Learner Expectations	Notes
	The student should:	
• Pipe/Tube Preparation	• calculate the cut angle for a butt joint in relation to the wall thickness and intended application • prepare a template for one or more of the following joints: – 90° two-piece turn – full T-joint – full lateral joint – butt joint.	Explain the need for multiple passes when wall thickness exceeds 5 mm (3/16"). Discuss methods used to fabricate T, K and Y tubular joints.
Implementation • Welding Process	• perform a vee groove weld using roll and position pipe welding techniques • prepare and perform: – full T-joint – full lateral joint tube and pipe weld.	Explain the advantage of roll over positioned welding techniques. Discuss procedures to restart and end a weld.
Assessment • Quality Control	• apply suitable destructive and non-destructive tests to ensure weld quality	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3080: AUTOMATED WELDING

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB3170 Gas Metal Arc Welding 2

Module Description: Students investigate and describe the operation of various manual, semi-automated and automated welding processes and systems used in fabrication industries.

Modular Parameters: Access to welding facility complete with welding equipment and supplies and to instruction from an individual with welding trade qualifications.

Supporting Modules: FAB2030 Oxyfuel Welding
FAB2040 Thermal Cutting
FAB2060 Arc Welding 2

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• explain how manual, semi-automated and automated welding processes differ from one another	• the presentation of a written report that outlines the essential differences and similarities between manual, semi-automated and automated welding processes	20
• identify employment and further training opportunities related to production welding	• presentation of an occupational profile that outlines the: – description of the trade/occupation and working conditions – employment opportunities – training requirements and opportunities. *Assessment Tool* *Assessment Framework: Presentations/Reports, CTSPRE* *Standard* *Performance rating of 3 for each applicable task*	20
• apply knowledge of advanced welding processes to demonstrate/simulate an automated welding system	• demonstration of a working or simulated automated welding system. *Assessment Tool* *Assessment Framework: Activity Assessment, FABACT* *Standard* *Performance rating of 3 for each applicable task*	60

MODULE FAB3080: AUTOMATED WELDING (continued)

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• identify the hazards associated with specific machine and automated processes • describe methods that are commonly used to protect an individual from injury by an automated system such as a robot • describe a safety plan in case of accident	
• Production Processes	• explain the difference between: – manual – semi-automated – automated cutting and welding processes • describe the specialized welding techniques that are suitable for semi-automated processes; e.g.: – resistance welding – GMAW – GTAW – plasma arc cutting – laser beam welding and cutting	Students will likely need to go off-campus to observe automated cutting and welding processes.
• Automated Welding and Cutting	• research the use of robots in welding to determine their advantages and disadvantages • identify the main types of robots and describe their work envelope • identify the main parts of a robot and the components of a robotic welding system	

Concept	Specific Learner Expectations	Notes
	The student should:	
• Automated Welding and Cutting (continued)	• describe the use of a teach pendent in programming a robot to perform the designated task.	
Implementation • Application	• demonstrate or simulate a viable production system using semi- and/or fully automated processes.	
Assessment • Career Preparation	• identify career opportunities related to the use of automated welding processes in industry • prepare a record of completed activities within a portfolio.	

MODULE FAB3090: SHEET FABRICATION 4 (RADIAL LINE)

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2100 Sheet Fabrication 3 (Parallel Line)

Module Description: Students develop specialized skills in cylindrical and conical pattern development and seam construction of ferrous and nonferrous sheet metals.

Module Parameters: Access to a fabrication facility complete with sheet metal shearing, forming, fastening and layout tools and to instruction from an individual with specialized training in sheet metal practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the procedures that are used to lay out a typical cylindrical and conical shape	• accurate identification and description of parallel and radial line layout procedures	10
• demonstrate parallel and radial line pattern making skills	• application parallel and radial line development processes to produce a cylindrical and conical pattern	25
• perform advanced cylindrical and conical sheet stock fabrication skills and processes	• successful completion of sheet metal products that incorporate cylindrical and conical shapes. *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD* *Standard* *The products are to be structurally sound, free of surface blemishes and hazards; and conform to stated overall sizes, shapes and tolerances* *Performance rating of 3 for each applicable task*	65
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
Orientation	*The student should:*	
• Ferrous and Nonferrous Stock	• research the properties of and applications of the following sheet materials: – aluminum – copper – brass – galvanized steel – mild steel – stainless steel – tin plate • describe which materials are most malleable • describe the techniques that are used to form sheet stock	
• Fabrication Processes and Tools	• describe the type of pattern development that is used to lay out a: – cylinder – cone – rectangle to round • explain when single, double, grooved and wired seams are used in conjunction with cylindrical and conical fabrication • identify and describe the use of the following solder coppers: – square point – bottoming – roofing.	
Planning and Management		
• Measurement	• use a micrometer caliper or sheet gauge to measure the thickness of a piece of sheet stock • calculate the inside, outside and mean diameter of a cylindrical component • identify the correct formula to calculate the allowances for seam and edges	

Concept	Specific Learner Expectations	Notes
• Product Design	*The student should:* • select a product that incorporates: – cylindrical and conical shapes – grooved and double seams – solder joints and finished edges • select the appropriate material for a given product and finish • create the necessary pattern development, using a computer or conventional means.	Students may require additional assistance and time to create a conical pattern. Consider projects such as a: – funnel – watering can – vase.
Implementation • Material Processing	• use the appropriate tools, materials and processes to: – cut and bend sheet stock – raise and finish a surface – locate and make joints watertight	
• Personal and Tool Safety	• wear personal protective clothing and equipment • show that tools are kept in working order • handle, store and discard metal off-cuts in a correct manner.	
Assessment • Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3110: SHEET FABRICATION 5 (DUCT COMPONENTS)

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2100 Sheet Fabrication 3 (Parallel Line)

Module Description: Students apply and develop specialized skills in duct component pattern making and fabrication techniques.

Module Parameters: Access to a fabrication facility complete with sheet metal shearing, forming, fastening and layout tools and to instruction from an individual with specialized training in sheet metal practices.

Supporting Module: FAB3090 Sheet Fabrication 4 (Radial Line)

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• identify common duct components and applications	• accurate identification and description of: – radius elbow – riser – offset – branch tee – take-off components	10
• demonstrate the principle of triangulation to create a transition pattern	• application of triangulation principles to produce a transition pattern	25
• apply pattern making and sheet metal fabrication skills to create a duct component	• successful completion of one or more interconnecting duct components. *Assessment Tool* *Assessment Framework: Activity Assessment, FABACT* *Standard* *The components are to be structurally sound and air tight; surfaces are to be free of blemishes and hazards. Components should be constructed to meet stated sizes and tolerances* *Performance rating of 3 for each applicable task*	65

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Ducting	• prepare a list of duct system applications • list and state the purpose of the following components used in a duct system: – radius elbow – riser – offset – branch tee – take off • describe how air volume and pressures are measured • analyze the effect of component resistance on static and velocity air pressures in a ducting system	Explain why it is important for duct components to be sized accurately.
• Fabrication Processes	• list and describe the use and construction of the following joints: – S and drive – T-lock – hammerlock – government locks • state the advantages and disadvantages of using each of the above systems • differentiate among the use of parallel line, radial line and triangulation in pattern development.	

MODULE FAB3110: SHEET FABRICATION 5 (DUCT COMPONENTS) (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management • Pattern Development	• calculate the material allowance for: – S and drive – T-lock – hammerlock • use triangulation to develop a pattern for an object whose sides are not parallel.	Students may require additional assistance and time to develop a pattern.
Implementation • Material Processing	• use the appropriate tools, materials and processes to fabricate specific components in a ducting system.	Consider one of the following components: – reducing elbow – square elbow – reducing offset – rectangular to round offset.
Assessment • Career Assessment • Career Preparation	• describe the trade qualifications and work opportunities related to sheet metal fabrication • prepare a record of completed activities within a portfolio.	

MODULE FAB3120: FOUNDRY 3 (CORE MOLDING)

Level: Advanced

Theme: Production Systems and Processes

Prerequisite: FAB1120 Foundry 1 (One-piece Pattern)

Module Description: Students investigate and apply advanced foundry processes to produce a hollow casting, using a sand and core mold.

Module Parameters: Access to a fabrication facility complete with foundry equipment and supplies and to instruction from an individual with specialized training in foundry practices.

Supporting Module: FAB2120 Foundry 2 (Split Pattern)

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• list and describe common core materials and production processes	• written or oral report that: – describes how cores are designed and fabricated – lists four different core binders and setting techniques – explains how cores are placed and reinforced in a mold. *Assessment Tool* *Assessment Framework: Presentations/Reports, CTSPRE* *Standard* *Performance rating of 3 for each applicable task*	10
• demonstrate advanced sand casting and coring skills and techniques	• completion of a hollow casting using an appropriate coring technique. *Assessment Tool* *Assessment Framework: Product Assessment, FABPRD* *Standard* *The core should break down at the end of the casting process and be easily removed. The casting should be clean and free of voids and meet size, shape and finish expectations.* *Performance rating of 3 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• create a profile of a trade or occupation within the foundry field	• presentation of an occupational profile that outlines: – description of the trade/occupation and conditions of work – employment opportunities – training requirements and opportunities. *Assessment Tool* *Assessment Framework: Research Process, CTSRES* *Standard* *Performance rating of 3 for each applicable task*	20
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Cores	• explain the purpose of a core and provide examples of products that require their use in casting • describe the variables and characteristics of good core mix	An engine block is a good example of a part that requires cores.
• Binders	• identify common binders that can be used with core sand; e.g.: sodium silicate and CO_2, linseed oil, wheat flour and molasses and other commercially prepared products	
• Core Construction	• identify common shapes and methods of producing and drying a core	
• Core Placement	• research and describe common methods of supporting core in mold cavity.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management • Core Design	• for a given casting, identify the appropriate core shape placement technique, core mix and reinforcement techniques • prepare a sketch showing the location of: – parting line and type of mold – core and core prints – venting, gating and pouring system for a given casting	
• Health and Safety	• describe safety concerns related to: – personal protective equipment – mold construction – foundry furnace start-up and shut-down procedures – heating and pouring procedures – cleaning and finishing castings • describe a safety plan in case of accident	
Implementation • Material Processing	• create a casting using common pattern making, coring and pouring techniques • clean and finish the casting according to specification.	Begin with a simple part such as a hollow cylinder that could later be machined into a collar or bushing.
Assessment • Quality Control	• analyze the overall size, shape and structural soundness of the product	
• Career Information	• identify ways to gain experience and further training in foundry work • research and describe career and further training opportunities related to foundry work • evaluate personal interests and abilities related to making realistic career choices	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3130: PRECISION TURNING 2

Level: Advanced

Theme: Production Systems and Processes

Prerequisite: FAB2130 Precision Turning 1

Module Description: Students develop specialized lathe skills for thread cutting and taper turning techniques.

Module Parameters: Access to a fabrication facility complete with metal lathe and accessories and to instruction from an individual with specialized training in metal lathe practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate print reading and job sequencing competencies	• application of print reading and organizing skills to prepare a safe and efficient sequence of machining operations	20
• perform safe taper turning and thread cutting set-up procedures	• demonstration of approved practices to set up a lathe for: – taper turning – thread cutting	10
• perform taper turning and thread cutting operations	• completion of the following machining operations: – outside and inside tapers – outside and inside right hand threading. *Assessment Tool* *Assessment Framework: Fabrication Process, FABPRS* *Standard* *Dimensions, levels of finish and fits are to be within stated tolerances and specifications* *Performance rating of 3 for each applicable task*	70
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• describe the hazards associated with metal lathes and metal cutting operations • describe a safety plan in case of accident	
• Lathe Accessories	• list and describe common lathe accessories such as drill chuck, taper attachment and thread dial	
• Taper Turning	• list and describe common types of tapers such as: – Morse taper – standard milling machine taper – taper pins	
	• observe methods of cutting a taper by using the: – compound rest – tailstock offset – taper attachment methods	Demonstrate these processes on the lathe.
	• identify the factors that determine the most efficient method of cutting a taper such as the: – length and angle of taper – quality of finish – number of duplicates	
• Threading	• identify the parts of a thread	
	• list and describe the principal features of a: – Unified National Coarse (UNC) – Unified National Fine (UNF) – tapered pipe thread – IS0 metric thread	Consider also a square, ACME, B.S.W. and buttress thread.
	• describe the set-up procedures to cut internal and external left- and right-handed threads • describe the classes of fit associated with Unified Thread system	

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Print Reading	• use a machine drawing to identify the: – overall size and shape of a machine part – thread type, size, tolerance and fit – taper type, size and fit – materials	
• Boring	• research hole-machining operations procedures	
• Work Sequencing	• create a systematic sequence of operations to machine a given part • calculate the appropriate cutting speeds, feed rates and depth of cuts for a given operation.	
Implementation		
• Taper Turning and Thread Cutting	• demonstrate skills in: – hole-machining operations – inside and outside taper turning – cutting inside and outside threads.	
Assessment		
• Career Information	• describe career and further training opportunities related to precision lathe work	If possible, have students visit a local machine or repair shop.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3140: PRECISION MILLING 2

Level: Advanced

Theme: Production Systems and Processes

Prerequisite: FAB2140 Precision Milling 1

Module Description: Students develop specialized skills to use vertical and/or horizontal milling machines.

Module Parameters: Students have access to a fabrication facility complete with horizontal mill plus accessories and to instruction from an individual with specialized training in advanced level machining practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate print reading and job sequencing competencies	• application of print reading and sequencing skills to prepare a safe and efficient sequence of milling operations	20
• perform safe vertical and/or horizontal mill set-up procedures	• demonstrate approved practices to set up a vertical or horizontal mill to cut: – grooves – keyways – gear teeth	10
• perform groove keyway and gear cutting operations	• completion of one or more of the following milling operations: – groove/slot – keyway – gear. *Assessment Tool* *Assessment Framework: Fabrication Process, FABPRS* *Standard* *Dimensions and levels of fit are to be within the stated tolerances and specifications* *Performance rating of 3 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Health and Safety	• describe the hazards associated with manual milling operations • describe a safety plan in case of accident	
• Milling Operations	• describe safe set-up procedures to mill grooves, keyways and gear teeth	
• Cutters	• identify and describe the types of cutters that are available for cutting common grooves/slots, keyways and gear teeth	Teacher should be prepared to demonstrate each of these processes.
	• explain the difference between a high speed steel and a tungsten carbide cutter	
	• identify the conditions that produce cutter failure such as: – excessive heat – clogging – work hardening	Consider cutting and feed rates; material harness and condition of the cutters.
• Indexing	• identify common machine parts that require indexing • describe how an indexing head is used when cutting a spur gear.	

Concept	Specific Learner Expectations	Notes
	The student should:	
Planning and Management		
• Print Reading	• use a machine drawing to determine: – overall size and shape of a machine part – specific types and sizes of grooves/slots, keyways and gear teeth	
• Work Sequencing	• list and describe the machining operations for a given machine part and/or feature in a logical sequence • identify the appropriate type of milling machine and cutters for each operation • select work piece holding device	
	• calculate the appropriate cutting speeds, feed rates and recommended depths of cut for a given operation	Student calculations should be checked prior to their use.
	• select appropriate cutting fluids.	
Implementation	• demonstrate skills in milling: – grooves/slots – keyways – gear teeth.	
Assessment		
• Career Information	• identify career and further training opportunities related to precision milling	Remind students that conventional machining processes will remain; however, new methods such as laser, electric and electrochemical processes are emerging as alternative ways of machining.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3150: CNC MILLING (COMPUTER NUMERICAL CONTROL)

Level: Advanced

Theme: Production Systems and Processes

Prerequisite: FAB1130 Principles of Machining

Module Description: Students develop skills in computer numerical control (CNC) programming to manufacture a three-dimensional product.

Module Parameters: Access to a CNC milling centre and to instruction from an individual with specialized training in CNC mill work.

Supporting Module: FAB2150 CNC Turning (Computer Numerical Control)

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• demonstrate three-dimensional CNC programming skills	• development of a 3-D program to produce a machineable part on a CNC mill using absolute coordinates, canned cycles and/or CAD file conversion	60
• apply CNC programming and operating skills to manufacture a milled part	• performing the appropriate programming set-up, testing and running procedures to produce a milled part	30
• identify further training and employment opportunities related to CNC machining	• presentation of an occupational profile that outlines: – description of the occupation and conditions of work – employment opportunities – training requirements and locations. *Assessment Tool* *Assessment Framework: Research Process, CTSRES* *Standard* *Performance rating of 3 in each applicable task*	10
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• Mill Operation	• after observing the operation of a CNC mill, describe how the cutting speeds, feed rates and depth of cuts are controlled; cutting tools and different sizes and shapes of workpieces are mounted • identify milling capabilities of a given machine, e.g.: size of cutters, size and types of materials • describe the safety features that are built into the CNC equipment	Demonstrate how to program and use a CNC mill using pre-designed/programmed part.
• Programming	• identify the relationship of the x, y and z axis on a vertical milling machine • determine how to program a CNC mill using absolute coordinates	
• Canned Cycles	• describe the types of canned cycles used in machining operations • identify when to use canned cycles to improve efficiency • list the information required to calculate and format a canned cycle.	
Planning and Management		
• Health and Safety	• describe the: – appropriate use of personal protective equipment – importance of keeping all covers and guards in place and following the manufacturer's recommendations – need to keep the work area clean and free of personal hazards • describe a safety plan in case of accident	
• 3-D Programming	• prepare a program from a print using absolute coordinates and/or produce a CAD design.	

Concept	Specific Learner Expectations	Notes
Implementation	*The student should:* • load the program or convert a CAD file • mount and secure the workpiece • identify reference and clearance points • mount and set cutting tool(s) • carry out a test run • manufacture the part.	
Assessment • Quality Control	• inspect the part to see that it meets the print dimensions, tolerances and specifications	Note: This field is expanding as new technology is developed and applications are found.
• Career Information	• research and describe further education and work opportunities related to the use of computer-controlled equipment • evaluate personal interests and abilities related to making realistic career choices • prepare a record of completed activities within a portfolio.	

MODULE FAB3160: PREFABRICATION PRINCIPLES

Level: Advanced

Theme: Production Systems and Processes

Prerequisite: FAB2160 Custom Fabrication

Module Description: Students work in a cooperative learning environment to plan and construct a prefabricated product/ structure to meet the specific needs of a client.

Module Parameters: Access to fabrication facilities and equipment and to instruction from an individual with journeyman qualifications if students are involved in customer work related to welding or other trade-related activities.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• perform basic shop drawing take-off skills	• development of an accurate cutting list and fabrication flow chart	20
• demonstrate advanced level resource management skills	• observed resource management skills used to access and deploy human and material resources	20
• demonstrate appropriate prefabrication skills and practices	• successful prefabrication of a component that fulfills the design specifications, quality and quantity requirements. *Assessment Tool* *Product Assessment: Prefabricated Project, FAB3160-1* *Illustrative Example, Gear Puller, FAB3160-2* *Standard* *Jigs and fixtures are to be developed and appropriate tools and materials acquired and used efficiently through proper scheduling and time allocations*	60
• demonstrate basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation • Prefabrication Principles	• cite examples of products that are built from prefabricated parts • describe the advantages and disadvantages of prefabricating a component • identify specific design considerations that must be adhered to when using prefabricated components • explain procedures that are used to create a cutting list from a shop drawing • describe safe rigging procedures that are used to move materials and components.	Greater efficiency and productivity are achieved by using prefabrication processes. However, extra care must be taken to ensure that components have been accurately designed and fabricated in the shop prior to the assembly on site.
Planning and Management	• create a cutting list from a shop drawing • prepare the required templates jigs and fixtures • locate appropriate materials and supplies • identify specialized equipment and processes that will be required • prepare production flow chart	
• Quality Customer Service	• show how to meet with the customer to determine the product/structure specifications • create a suitable prefabricated design, timeline and budget • show how to apprise the customer of any need to make changes.	Good communication between the customer, designer engineer and fabricator is a must. Students need to develop their interpersonal and communication skills.

Concept	Specific Learner Expectations	Notes
	The student should:	
Implementation • Material Processing	• assign responsibilities to: – break out materials according to a prearranged plan – process materials with a minimum number of set-ups – assemble, finish and prepare the product for delivery • explain the need to: – identify group and individual responsibilities – identify and capitalize on individual strengths • help install/assemble the product if contracted.	
Assessment • Quality Control	• participate in group and self-evaluation processes • demonstrate strategies for positive criticism • complete a customer satisfaction follow-up survey	Students need to understand the importance of having good intra- and interpersonal skills.
• Career Preparation	• prepare a record of completed activities within a portfolio.	

MODULE FAB3170: GAS METAL ARC WELDING 2

Level: Advanced

Theme: Fabrication Processes

Prerequisite: FAB2070 Gas Metal Arc Welding 1

Module Description: Students develop specific skills to assess and improve the quality of gas metal arc welding (GMAW) processes, and gain experience using flux cored arc welding (FCAW) processes.

Module Parameters: Access to a fabrication facility complete with gas metal arc and flux cored welding equipment and supplies and to instruction from an individual with formal, specialized training in welding trade practices.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• describe the characteristics of a desirable gas metal and flux cored arc weld	• a written or oral response that describes five visual characteristics of a weld that meet trade standards	20
• identify strategies to evaluate and improve weld quality	• assessment of a short arc transfer weld and list of corrective measures to improve quality of a weld given a cross-section and plan view	10
• demonstrate GMAW and FCAW competencies on mild steel plate in the flat, horizontal and vertical positions	• completion of two successive single and multiple pass fillet and groove welds in the flat, horizontal and vertical positions on mild steel using GMAW and FCAW processes. *Assessment Tool* *Fabrication Process: Fillet and Butt Welding on Mild Steel, FAB3170-1* *Illustrative Example: Horizontal Single Vee Butt Joint Weld, FAB3170–2* *Standard* *Welds are to be free of surface and subsurface porosity, show no evidence of burn through, lack of penetration or fusion.* *Performance rating of 3 for each applicable task*	70

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will: • demonstrate basic competencies.	*Assessment of student achievement should be based on:* • observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

Concept	Specific Learner Expectations	Notes
	The student should:	
Orientation		
• GMAW/FCAW Variables	• identify the parameters that can directly affect weld quality; e.g.: – weld current and voltage – type of shielding gas/flux – diameter and type of filler metal – type and condition of equipment	Explain the difference between FCAW and GMAW processes and consumables. Explain why changes to the welding current can greatly affect the quality of a weld.
• Gas Mixtures	• select the appropriate shielding gas mixture based on: – mode of metal transfer – base metal type and thickness – joint design – filler material – desired weld quality	
• Filler Metals	• describe how to select the type and size of filler metal • explain how to avoid contamination of filler materials	

Concept	Specific Learner Expectations	Notes
	The student should:	
• Arc Control	• identify the relationship between: – wire speed and amperage – welding voltage and arc length	
	• describe the effects of: – backhand or pull welding – forehand or push welding	Demonstrate backhand and forehand welding techniques.
	• describe the effects of torch angle on: – weld penetration – weld appearance	
• Weld Quality	• identify the probable causes of the following defects: – surface porosity – subsurface porosity – lack of fusion – burn through – lack of penetration.	
Planning and Management		
• Set-up	• identify the appropriate shielding gas and flow rate, filler wire and feed rate and current setting for a give weld.	Students may also be encouraged to use flux cored wire in this module since this process is gaining in use.
Implementation		
• Gas Metal Arc Welding	• make single and multipass fillet and groove welds on mild steel plate in the flat, horizontal and vertical positions	
• Weld Troubleshooting	• describe the corrective actions that can be taken to avoid: – surface porosity – subsurface porosity – lack of fusion – burn through – lack of penetration – cold lapping.	

MODULE FAB3170: GAS METAL ARC WELDING 2 (continued)

Concept	Specific Learner Expectations	Notes
	The student should:	
Assessment		
• Quality Control	• carry out destructive and non-destructive test where appropriate	
• Career Assessment	• explain employment and further training opportunities for GMAW	
• Career Preparation	• prepare a record of completed activities within a portfolio.	

FABRICATION STUDIES

SECTION G: ASSESSMENT TOOLS

The following pages comprise background information and strategies for assessing student achievement and the assessment tools that are listed in Sections D, E and F of this Guide.

This section of the Guide to Standards and Implementation has been designed to provide a common base of understanding about the level of competencies students are expected to demonstrate to successfully complete a 1-credit course. The goal is to establish assessment standards for junior and senior high school students that are fair, credible and challenging.

These tools will assist teachers throughout the province to more consistently assess student achievement. The purpose of expanding on the assessment standards is to:

- increase confidence among students, parents, business/ industry and post-secondary that students can demonstrate the competencies specified in the courses they have completed
- encourage fairness and equity in how students' efforts are judged
- enable learners to focus effort on key learnings
- support teachers and community partners in planning and implementing CTS.

These tools were validated during the optional stage of CTS implementation.

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ASSESSING STUDENT ACHIEVEMENT IN CTS

The CTS assessment standards assess two basic forms of competency:

- What can a student *do*?
  - **make** a product (e.g., wood bowl, report, garment)
  - **demonstrate** a process
    - strand-related competencies (e.g., keyboarding, hair cutting, sewing techniques, lab procedures)
    - basic competencies (e.g., resource use, safety procedures, teamwork).

- What does a student *know*?
  - knowledge base needed to demonstrate a competency (link theory and practice).

CTS Defines *Summative* Assessment Standards

The assessment standards and tools defined for the CTS courses, referenced in Sections D, E and F of this Guide, focus on the final (or summative) assessment of student achievement.

Assessment throughout the learning period (formative assessment) will continue to evaluate how students are progressing. Teachers direct and respond to students' efforts to learn—setting and marking tasks and assignments, indicating where improvement is needed, sending out interim reports, congratulating excellence, etc.

Teachers will decide which instructional and assessment strategies to apply during the formative learning period. As formative and summative assessment are closely linked, some teachers may wish to modify the tools included in this section to use during the instructional process. Teachers may also develop their own summative assessment tools as long as the standards are consistent with the minimum expectations outlined by Alberta Learning.

Grading and Reporting Student Achievement

When a student can demonstrate ALL of the exit-level competencies defined for a 1-credit course (general outcomes), the teacher will designate the course as "successfully completed." The teacher will then use accepted grading practices to determine the percentage grade to be given for the course—a mark not less than 50%.

The time frame a teacher allows a student to develop the exit-level competency is a local decision. NOTE: The *Guide to Education: ECS to Grade 12* specifies that students must have access to 25 hours of instruction for each credit. Students may, however, attain the required competencies in less time and may proceed to other courses.

Teachers are encouraged to consult their colleagues to ensure grading practices are as consistent as possible. Further information about assessing and reporting student achievement in CTS is provided in the *CTS Manual for Administrators, Counsellors and Teachers* (Assessing Student Achievement).

Components of Assessment Standards in CTS

The following components are included in each 1-credit course:

- **general outcomes** (in the shaded left column of the course) define the exit-level competencies students are expected to achieve to complete a course. Each general outcome defines and describes critical behaviours that can be measured and observed. The student must meet the standard specified for **ALL** the general outcomes within a course to be successful.

- **suggested emphasis** (in the right-hand column) provides a guideline for the relative significance of each general outcome and can be used to organize for instruction.

- **criteria and conditions** (in the middle column) set the framework for the assessment of student competency, specifying the minimum standard for performance and including a reference to assessment tools, where appropriate.

  Criteria define the behaviours that a student must demonstrate to meet the designated standard. For example, the criteria could describe the various techniques that must be demonstrated when using a tool, and/or describe the minimum components of a project the student must complete.

  Conditions outline the specifications under which a student's competency can be judged. For example, the conditions could specify whether the assessment should be timed or not, or if the student should be allowed to access to support resources or references.

  Standard may be defined by (1) assessment tools, which are referenced in this section (or sometimes in approved learning resources) and/or (2) "illustrative examples" of student work, if appropriate.

  Assessment Tools included in this section of the Guide tend to be of two types:

  - tools generic to a strand or to the entire CTS program; e.g., a standard five-point rating scale is used in all strands. Other generic tools include assessing reports and presentations and lab safety checklists. (*Names of these tools include the strand code [e.g., "INF" for Information Processing] and a code for the type of tool [e.g., "TDENT" for Text-Data Entry].)*
  - tools specific to a 1-credit course; e.g., assessment checklist for assessing a venture plan in Enterprise and Innovation or a checklist for sketching, drawing and modelling in Design Studies. *(Names of these tools include the course code; e.g., "INF1010–1" indicating that it is the first course-specific tool used in Information Processing Course 1010.)*

Development and Validation Processes

The "Criteria and Conditions" and "Suggested Emphasis" columns have been validated with extensive input from teachers, professional associations/contacts and post-secondary institutions. The goal was to prepare well-structured assessment standards and related assessment tools that:

- establish an appropriate level of challenge and rigour
- relate directly to the type of learning described in the curriculum standard
- are easy to understand
- are efficient to implement
- can provide a consistent measure of what was expected to be measured.

As students and teachers work with the assessment standards and tools, it is expected that levels of performance will increase as more and more students are able to achieve the minimum standard. Therefore, the assessment standards and related tools will continue to be monitored, and revised as necessary to ensure appropriate levels of rigour and challenge, and successful transitions for students as they leave high school and enter the workplace or related post-secondary programs.

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ASSESSING STUDENT ACHIEVEMENT IN FABRICATION STUDIES

Much of the assessment in Fabrication Studies consists of gathering information about what a student knows and is able to do and being able to compare those outcomes with the standards identified within the curriculum.

Assessing student performance in Fabrication Studies values process as well as product. Its focus is primarily on the measurement and reporting on how well a student applies knowledge and skills to complete a given task rather than the simple acquisition of knowledge and skills.

Assessment Strategies and Tools

A variety of tools have been provided for your reference and use. In the development of the assessment materials there has been an attempt to keep it as simple as possible while also providing guidance and assistance to the teacher. The tools are intended to help you assess students' work as accurately and consistently as possible by stating standards of performance for elements felt to be important within the curriculum as a whole or in specific courses. They also provide standards for "basic competencies" students should be able to demonstrate while engaged in learning.

The tools that have been developed are intended to be used as summative assessment tools. Depending on the way the classroom is organized, they may be used when the student has indicated he or she is ready for the final assessment or by the entire class at the end of the learning period.

Tools Generic to Fabrication Studies

Throughout the Fabrication Studies strand, students are engaged in activities and projects that involve the application of knowledge and use of a variety of skills and techniques. Frameworks for assessing student activities, project work and Fabrication processes have been developed for each of the introductory, intermediate and advanced levels. These frameworks are identified as *FABACT*, *FABPRD* and *FABPRS* respectively.

In addition to "Equipment Checklists" that identify proper set-up, operating and shutdown procedures for specific tools, a "Response Rating Scale" has been developed to help assess the application of knowledge and related content.

Tools Specific to Fabrication Studies Courses

The tools that have been developed to assess specific general outcomes in a course are labelled with the course number and the tool number; e.g., FAB1040–1. They are referenced in the conditions and criteria section for each course.

The assessment tools outline the criteria for assessment and the minimum task performance rating using a five-point scale. These standards establish an appropriate level of performance and achievement for one or more general outcomes.

A number of course-specific assessment tools have been developed around the frameworks generic to CTS and the strand. These tools identify basic as well as strand-specific skill sets, such as:

- Planning and Management
- Information Gathering and Processing
- Presenting/Reporting
- Use of Equipment and Materials
- Fabrication Techniques.

Where appropriate, "Illustrative Examples" have also been developed to help establish realistic expectations and standards of achievement.

Career exploration is integrated throughout the Fabrication Studies strand and is assessed using dedicated tools or as a component of a tool.

BASIC COMPETENCIES REFERENCE GUIDE

The chart below outlines basic competencies that students endeavour to develop and enhance in each of the CTS strands and courses. Students' basic competencies should be assessed through observations involving the student, teacher(s), peers and others as they complete the requirements for each course. In general, there is a progression of task complexity and student initiative as outlined in the Developmental Framework★. **As students progress through Stages 1, 2, 3 and 4 of this reference guide, they build on the competencies gained in earlier stages.** Students leaving high school should set themselves a goal of being able to demonstrate Stage 3 performance.

Suggested strategies for classroom use include:

- having students rate themselves and each other
- using in reflective conversation between teacher and student
- highlighting areas of strength
- tracking growth in various CTS strands
- highlighting areas upon which to focus
- maintaining a student portfolio.

Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Managing Learning			
☐ comes to class prepared for learning	☐ ————▶————▶	☐ ————▶————▶	☐ ————▶————▶
☐ follows basic instructions, as directed	☐ follows instructions, with limited direction ☐ sets goals and establishes steps to achieve them, with direction	☐ follows detailed instructions on an independent basis ☐ sets clear goals and establishes steps to achieve them	☐ ————▶————▶ ☐ demonstrates self-direction in learning, goal setting and goal achievement
☐ acquires specialized knowledge, skills and attitudes	☐ applies specialized knowledge, skills and attitudes in practical situations	☐ transfers and applies specialized knowledge, skills and attitudes in a variety of situations	☐ transfers and applies learning in new situations; demonstrates commitment to lifelong learning
☐ identifies criteria for evaluating choices and making decisions	☐ identifies and applies a range of effective strategies for solving problems and making decisions	☐ uses a range of critical thinking skills to evaluate situations, solve problems and make decisions	☐ thinks critically and acts logically to evaluate situations, solve problems and make decisions
☐ uses a variety of learning strategies	☐ explores and uses a variety of learning strategies, with limited direction	☐ selects and uses effective learning strategies ☐ cooperates with others in the effective use of learning strategies	☐ ————▶————▶ ☐ provides leadership in the effective use of learning strategies
Managing Resources			
☐ adheres to established timelines; uses time/schedules/planners effectively	☐ creates and adheres to timelines, with limited direction; uses time/schedules/planners effectively	☐ creates and adheres to detailed timelines on an independent basis; prioritizes task; uses time/schedules/planners effectively	☐ creates and adheres to detailed timelines; uses time/schedules/planners effectively; prioritizes tasks on a consistent basis
☐ uses information (material and human resources), as directed	☐ accesses and uses a range of relevant information (material and human resources), with limited direction	☐ accesses a range of information (material and human resources), and recognizes when additional resources are required	☐ uses a wide range of information (material and human resources) in order to support and enhance the basic requirement
☐ uses technology (facilities, equipment, supplies), as directed, to perform a task or provide a service	☐ uses technology (facilities, equipment, supplies), as appropriate, to perform a task or provide a service, with minimal assistance and supervision	☐ selects and uses appropriate technology (facilities, equipment, supplies) to perform a task or provide a service on an independent basis	☐ recognizes the monetary and intrinsic value of managing technology (facilities, equipment, supplies)
☐ maintains, stores and/or disposes of equipment and materials, as directed	☐ maintains, stores and/or disposes of equipment and materials, with limited assistance	☐ maintains, stores and/or disposes of equipment and materials on an independent basis	☐ demonstrates effective techniques for managing facilities, equipment and supplies
Problem Solving and Innovation			
☐ participates in problem solving as a process ☐ learns a range of problem-solving skills and approaches	☐ identifies the problem and selects an appropriate problem-solving approach, responding appropriately to specified goals and constraints	☐ thinks critically and acts logically in the context of problem solving	☐ identifies and resolves problems efficiently and effectively
☐ practises problem-solving skills by responding appropriately to a clearly defined problem, specified goals and constraints, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ applies problem-solving skills to a directed or a self-directed activity, by: – generating alternatives – evaluating alternatives – selecting appropriate alternative(s) – taking action	☐ transfers problem-solving skills to real-life situations, by generating new possibilities ☐ prepares implementation plans ☐ recognizes risks	☐ identifies and suggests new ideas to get the job done creatively, by: – combining ideas or information in new ways – making connections among seemingly unrelated ideas – seeking out opportunities in an active manner

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Stage 1— *The student:*	**Stage 2**— *The student:*	**Stage 3**— *The student:*	**Stage 4**— *The student:*
Communicating Effectively			
☐ uses communication skills; e.g., reading, writing, illustrating, speaking	☐ communicates thoughts, feelings and ideas to justify or challenge a position, using written, oral and/or visual means	☐ prepares and effectively presents accurate, concise, written, visual and/or oral reports providing reasoned arguments	☐ negotiates effectively, by working toward an agreement that may involve exchanging specific resources or resolving divergent interests
☐ uses language in appropriate context	☐ uses technical language appropriately	☐ encourages, persuades, convinces or otherwise motivates individuals	☐ negotiates and works toward a consensus
☐ listens to understand and learn	☐ listens and responds to understand and learn	☐ listens and responds to understand, learn and teach	☐ listens and responds to understand, learn, teach and evaluate
☐ demonstrates positive interpersonal skills in selected contexts	☐ demonstrates positive interpersonal skills in many contexts	☐ demonstrates positive interpersonal skills in most contexts	☐ promotes positive interpersonal skills among others
Working with Others			
☐ fulfills responsibility in a group project	☐ →	☐ seeks a team approach, as appropriate, based on group needs and benefits; e.g., idea potential, variety of strengths, sharing of workload	☐ leads, where appropriate, mobilizing the group for high performance
☐ works collaboratively in structured situations with peer members	☐ cooperates to achieve group results	☐ works in a team or group: – encourages and supports team members – helps others in a positive manner – provides leadership/followership as required – negotiates and works toward consensus as required	☐ understands and works within the context of the group
☐ acknowledges the opinions and contributions of others in the group	☐ maintains a balance between speaking, listening and responding in group discussions		☐ prepares, validates and implements plans that reveal new possibilities
	☐ respects the feelings and views of others		
Demonstrating Responsibility			
Attendance			
☐ demonstrates responsibility in attendance, punctuality and task completion	☐ →	☐ →	☐ →
Safety			
☐ follows personal and environmental health and safety procedures	☐ recognizes and follows personal and environmental health and safety procedures	☐ establishes and follows personal and environmental health and safety procedures	☐ transfers and applies personal and environmental health and safety procedures to a variety of environments and situations
☐ identifies immediate hazards and their impact on self, others and the environment	☐ identifies immediate and potential hazards and their impact on self, others and the environment	☐ →	☐ →
☐ follows appropriate/emergency response procedures	☐ →	☐ →	☐ →
			☐ demonstrates accountability for actions taken to address immediate and potential hazards
Ethics			
☐ makes personal judgements about whether or not certain behaviours/actions are right or wrong	☐ assesses how personal judgements affect other peer members and/or family; e.g., home and school	☐ assesses the implications of personal/group actions within the broader community; e.g., workplace	☐ analyzes the implications of personal/group actions within the global context
			☐ states and defends a personal code of ethics as required

★Developmental Framework • *Simple task* • *Structured environment* • *Directed learning*	• *Task with limited variables* • *Less structured environment* • *Limited direction*	• *Task with multiple variables* • *Flexible environment* • *Self-directed learning, seeking assistance as required*	• *Complex task* • *Open environment* • *Self-directed/self-motivated*

GENERIC RATING SCALE

SCALE	**RUBRIC STATEMENT** **(included in assessment tool/statements in *italics* are optional)** ***The student:***	**IS TASK/ PROJECT COMPLETED?**	**PROBLEM SOLVING:** **STUDENT INITIATIVE VS TEACHER DIRECTION/ SUPPORT**	**USE OF TOOLS, MATERIALS, PROCESSES**	***STANDARDS OF QUALITY/ PRODUCTIVITY***	***TEAMWORK*** ***LEADERSHIP***	***SERVICE*** ***CLIENT/*** ***CUSTOMER***
4	exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. Analyzes and provides effective client/customer services beyond expectations.*	Exceeds defined outcomes.	Plans and solves problems effectively and creatively in a self-directed manner.	Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.	*Quality, particularly details and finishes, and productivity are consistent and exceed standards.*	*Leads others to contribute team goals.*	*Analyzes and provides effective client/customer services beyond expectations.*
3	meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort. Analyzes and provides effective client/customer services.*	Meets defined outcomes.	Plans and solves problems in a self-directed manner.	Tools, materials and/or processes are selected and used efficiently and effectively.	*Quality and productivity are consistent.*	*Works cooperatively and contributes ideas and suggestions that enhance team effort.*	*Analyzes and provides effective client/customer services.*
2	meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals. Identifies and provides customer/client services.*	Meets defined outcomes.	Plans and solves problems with limited assistance.	Tools, materials and/or processes are selected and used appropriately.	*Quality and productivity are reasonably consistent.*	*Works cooperatively to achieve team goals.*	*Identifies and provides customer/client services.*
1	meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively. Provides a limited range of customer/client services.*	Meets defined outcomes.	Follows a guided plan of action.	A limited range of tools, materials and/or processes are used appropriately.	*Quality and productivity are reasonably consistent.*	*Works cooperatively.*	*Provides a limited range of customer/client services.*
0	has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.	Has not completed defined outcomes.		Tools, materials and/or processes are used inappropriately.			

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ASSESSMENT FRAMEWORK: ISSUE ANALYSIS

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • accurately describes an issue on which people disagree • poses an important question regarding the issue • accesses basic in-school/community information sources regarding the issue • uses one or more information-gathering techniques	**Preparation and Planning** • accurately describes an issue on which people disagree, explaining areas of disagreement • poses one or more thoughtful questions regarding the issue • accesses a range of relevant in-school/community resources • uses a range of information-gathering techniques	**Preparation and Planning** • accurately describes an issue on which people disagree, explaining specific causes of disagreement • poses thoughtful questions regarding the issue • accesses a range of relevant information sources and recognizes when additional information is required • demonstrates resourcefulness in collecting data
Analyzing Perspectives • clarifies different points of view regarding the issue; *e.g., social, economic, environmental* • states a position on the issue and logical reasons for adopting that position • states an opposing position on the issue and logical reasons for adopting that position • identifies sources of conflict among different positions • distinguishes between fact and fiction/opinion/theory	**Analyzing Perspectives** • categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related* • states a position on the issue and logical reasons for adopting that position • states two or more opposing positions on the issue and logical reasons for adopting each position • describes interrelationships among different perspectives/points of view • determines accuracy/currency/reliability of information and ideas	**Analyzing Perspectives** • categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related, scientific, political* • states a position on the issue and insightful reasons for adopting that position • states three or more opposing positions on the issue and thoughtful reasons for adopting each position • analyzes interrelationships among different perspectives/points of view • recognizes underlying bias/assumptions/values in information and ideas
Collaboration and Teamwork • shares work appropriately among group members • respects the views of others	**Collaboration and Teamwork** • shares work appropriately among group members • respects and considers the views of others • negotiates solutions to problems	**Collaboration and Teamwork** • shares work appropriately among group members • respects and considers the views of others • negotiates with sensitivity solutions to problems
Evaluating Choices/Making Decisions • identifies useful alternatives regarding the issue • establishes criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate alternative based on established criteria • reflects on strengths/weaknesses of decisions by considering consequences • communicates information in a logical sequence to justify choices/decisions made	**Evaluating Choices/Making Decisions** • identifies important and appropriate alternatives regarding the issue • establishes knowledge- and value-based criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate alternative by showing differences among choices • assesses strengths/weaknesses of decisions by considering consequences • communicates ideas in a logical sequence with supporting detail to justify choices/decisions made	**Evaluating Choices/Making Decisions** • describes in detail important and appropriate alternatives regarding the issue • establishes knowledge- and value-based criteria for assessing each alternative; *e.g., social, economic, environmental* • selects an appropriate and useful alternative by showing differences among choices • assesses strengths/weaknesses of decisions by considering consequences and implications • communicates thoughts/feelings/ideas clearly to justify choices/decisions made

ASSESSMENT FRAMEWORK: LAB INVESTIGATIONS

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Management • prepares self for task • organizes and works in an orderly manner • carries out instructions accurately • uses time effectively	**Management** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions accurately • plans and uses time effectively • adheres to routine procedures	**Management** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions accurately • plans and uses time effectively in a logical sequence • displays leadership in adhering to routine procedures • attempts to solve problems prior to requesting help
Teamwork • cooperates with group members • shares work appropriately among group members	**Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates solutions to problems	**Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates with sensitivity solutions to problems • displays effective communication skills
Use of Equipment and Materials • selects and uses appropriate equipment/materials • follows safe procedures/techniques • weighs and measures accurately • returns clean equipment/materials to storage areas	**Use of Equipment and Materials** • selects and uses appropriate equipment/materials • models safe procedures/techniques • weighs and measures accurately • practises proper sanitation procedures • minimizes waste of materials • advises of potential hazards and necessary repairs	**Use of Equipment and Materials** • selects and uses equipment/materials independently • demonstrates concern for safe procedures/techniques • weighs and measures accurately and efficiently • practises proper sanitation procedures • minimizes waste of materials • anticipates potential hazards and emergency response
Investigative Techniques • gathers and applies information from at least one source • makes predictions that can be tested • sets up and conducts experiments to test a prediction • distinguishes between manipulated/responding variables • obtains results that can be used to determine if some aspect of the prediction is accurate • summarizes important experimental outcomes	**Investigative Techniques** • gathers and applies information from a variety of sources • makes predictions that can be tested • plans, sets up and conducts experiments to test a prediction • identifies and explains manipulated/responding variables • obtains accurate results that confirm/reject the prediction • summarizes and applies experimental outcomes	**Investigative Techniques** • uses relevant information to explain observations • makes predictions that can be tested • plans, sets up and conducts experiments to test a prediction • analyzes relationships among manipulated/responding variables • obtains accurate results that confirm/reject prediction and answer related questions • summarizes, applies and evaluates experimental outcomes

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ASSESSMENT FRAMEWORK: NEGOTIATION AND DEBATE

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning	**Preparation and Planning**	**Preparation and Planning**
• accurately describes an issue on which people disagree	• accurately describes an issue on which people disagree, explaining areas of disagreement	• accurately describes an issue on which people disagree, explaining specific causes of disagreement
• poses an important question regarding the issue	• poses one or more thoughtful questions regarding the issue	• poses thoughtful questions regarding the issue
• accesses basic in-school/community information sources regarding the issue	• accesses a range of relevant in-school/community resources	• accesses a range of relevant information sources and recognizes when additional information is required
• uses one or more information-gathering techniques	• uses a range of information-gathering techniques	• demonstrates resourcefulness in collecting data
Analyzing Perspectives	**Analyzing Perspectives**	**Analyzing Perspectives**
• states a position on the issue and logical reasons for adopting that position	• states a position on the issue and logical reasons for adopting that position	• states a position on the issue and insightful reasons for adopting that position
• explains why the issue is important by presenting examples of possible consequences	• explains why the issue is important by presenting examples of possible consequences	• explains why the issue is important by presenting examples of possible consequences and implications
• clarifies different points of view regarding the issue; *e.g., social, economic, environmental*	• categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related*	• categorizes different points of view regarding the issue; *e.g., cultural, ethical, economic, environmental, health-related, scientific, political*
• distinguishes between fact and fiction/opinion/theory	• determines accuracy/currency/reliability of information and ideas	• recognizes underlying bias/assumptions/values in information and ideas
Collaboration and Teamwork	**Collaboration and Teamwork**	**Collaboration and Teamwork**
• works with a range of peer members	• works with a range of peer members	• works with a wide range of peer members
• shares information/opinions/suggestions through group discussion	• shares information/opinions/suggestions, maintaining a balance between speaking and listening	• shares information/opinions/suggestions, maintaining a balance between speaking and listening
• listens to and respects the views of others	• listens to and respects the views of others, requesting clarification as necessary from other group members	• listens to and respects the views of others, requesting clarification as necessary from other group members
Negotiating and Debating	**Negotiating and Debating**	**Negotiating and Debating**
• presents a convincing argument in logical sequence supporting a position adopted on the issue	• presents a convincing argument in logical sequence supporting a position adopted, conveying points in order of importance	• presents a convincing argument in logical sequence supporting a position adopted, conveying points in order of importance and backing each with sound evidence
• provides a relevant response to opposing arguments	• provides a relevant and convincing response to opposing arguments	• provides a relevant and convincing rebuttal to opposing arguments
• speaks clearly so the argument can be understood	• speaks clearly without hesitation so the argument can be understood	• speaks clearly without hesitation so the argument can be understood by all listeners
• establishes a shared understanding of key alternatives and consequences relevant to the issue	• negotiates a shared agreement on preferred alternatives relevant to the issue	• negotiates a shared agreement on preferred alternatives by resolving divergent points of view

ASSESSMENT FRAMEWORK: PRESENTATIONS/REPORTS

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning	**Preparation and Planning**	**Preparation and Planning**
• sets goals and follows instructions accurately	• sets goals and describes steps to achieve them	• sets goals and describes steps to achieve them
• responds to directed questions and follows necessary steps to find answers	• uses personal initiative to formulate questions and find answers	• uses personal initiative to formulate questions and find answers
• accesses basic in-school/community information sources	• accesses a range of relevant in-school/community resources	• accesses a range of relevant information sources and recognizes when additional information is required
• interprets and organizes information into a logical sequence	• interprets, organizes and combines information into a logical sequence	• interprets, organizes and combines information in creative and thoughtful ways
• records information accurately, using correct technical terms	• records information accurately with appropriate supporting detail and using correct technical terms	• records information accurately, using appropriate technical terms and supporting detail
• uses time effectively	• plans and uses time effectively	• plans and uses time effectively, prioritizing tasks on a consistent basis
	• gathers and responds to feedback regarding approach to task and project status	• assesses and refines approach to task and project status based on feedback and reflection
Presentation	**Presentation**	**Presentation**
• demonstrates effective use of at least one medium of communication:	• demonstrates effective use of at least two communication media:	• demonstrates effective use of a variety of communication media:
e.g., Written: *spelling, punctuation, grammar, basic format*	*e.g., Written:* *spelling, punctuation, grammar, format (formal/informal)*	*e.g., Written:* *spelling, punctuation, grammar, format (formal/informal, technical/literary)*
Oral: *voice projection, body language*	*Oral:* *voice projection, body language, appearance*	*Oral:* *voice projection, body language, appearance, enthusiasm, evidence of prior practice*
Audio-visual: *techniques, tools*	*Audio-visual:* *techniques, tools, clarity*	*Audio-visual:* *techniques, tools, clarity, speed and pacing*
• uses correct grammatical convention and technical terms through proofreading/editing	• maintains acceptable grammatical and technical standards through proofreading and editing	• maintains acceptable grammatical and technical standards through proofreading and editing
• provides an introduction that describes the purpose of the project	• provides an introduction that describes the purpose and scope of the project	• provides an introduction that describes the purpose and scope of the project
• communicates information in a logical sequence	• communicates ideas into a logical sequence with sufficient supporting detail	• communicates thoughts/feelings/ideas clearly to justify or challenge a position
• states a conclusion based on a summary of facts	• states a conclusion by synthesizing the information gathered	• states a conclusion by analyzing and synthesizing the information gathered
• provides a reference list of three or more basic information sources	• provides a reference list that includes five or more relevant information sources	• gives evidence of adequate research through a reference list including seven or more relevant information sources

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INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • sets goals and follows instructions accurately • adheres to established timelines • responds to directed questions and follows necessary steps to find answers • uses time effectively	**Preparation and Planning** • sets goals and establishes steps to achieve them • creates and adheres to useful timelines • uses personal initiative to formulate questions and find answers • plans and uses time effectively	**Preparation and Planning** • sets clear goals and establishes steps to achieve them • creates and adheres to detailed timelines • uses personal initiative to formulate questions and find answers • plans and uses time effectively, prioritizing tasks on a consistent basis
Information Gathering and Processing • accesses basic in-school/community information sources • uses one or more information-gathering techniques • interprets and organizes information in a logical sequence • records information accurately, using correct technical terms • distinguishes between fact and fiction/opinion/theory • responds to feedback when current approach is not working	**Information Gathering and Processing** • accesses a range of relevant in-school/community resources • uses a range of information-gathering techniques • interprets, organizes and combines information into a logical sequence • records information accurately with appropriate supporting detail and using correct technical terms • determines accuracy/currency/reliability of information sources • gathers and responds to feedback regarding approach to the task	**Information Gathering and Processing** • accesses a range of relevant information sources and recognizes when additional information is required • demonstrates resourcefulness in collecting data • interprets, organizes and combines information in creative and thoughtful ways • records information accurately with appropriate supporting detail and using correct technical terms • recognizes underlying bias/assumptions/values in information sources • assesses and refines approach to the task and project status based on feedback and reflection
Collaboration and Teamwork • cooperates with group members • shares work appropriately among group members	**Collaboration and Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates solutions to problems	**Collaboration and Teamwork** • cooperates with group members • shares work appropriately among group members • negotiates with sensitivity solutions to problems • displays effective communication and leadership skills
Information Sharing • demonstrates effective use of one or more communication media; *e.g., written, oral, audio-visual* • communicates information in a logical sequence • uses correct grammatical convention and technical terms • cites three or more basic information sources	**Information Sharing** • demonstrates effective use of two or more communication media; *e.g., written, oral, audio-visual* • communicates ideas in a logical sequence with sufficient supporting detail • maintains acceptable grammatical and technical standards • cites five or more relevant information sources	**Information Sharing** • demonstrates effective use of a variety of communication media; *e.g., written, oral, audio-visual* • communicates thoughts/feelings/ideas clearly to justify or challenge a position • maintains acceptable grammatical and technical standards • gives evidence of adequate information gathering by citing seven or more relevant information sources

ASSESSMENT FRAMEWORK: ACTIVITY ASSESSMENT FABACT

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Planning and Management • prepares self for task • adheres to routine procedures • follows basic instructions • uses time effectively • asks for help when unsure	**Planning and Management** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions accurately • adheres to established timelines • thinks through the problem before asking for help.	**Planning and Management** • prepares for task and develops an effective work plan • interprets and carries out instructions accurately • plans and uses time in a logical manner • displays leadership in adhering to routine procedures • attempts to solve problems prior to requesting help.
Fabrication Techniques (refer to specific module)	**Fabrication Techniques** (refer to specific module)	**Fabrication Techniques** (refer to specific module)
Use of Equipment and Materials • uses recommended tools and materials safely • wears the proper personal protective equipment • follows proper lifting, handling and storage procedures • calculates and measures accurately • fulfills given clean-up responsibilities • recognizes potential health and safety hazards.	**Use of Equipment and Materials** • selects and uses appropriate equipment/ materials safely • uses proper personal protective equipment • observes proper lifting, handling and storage procedures • calculates and measures accurately • minimizes waste of materials • fulfills expected clean-up responsibilities • recognizes and controls potential health and safety hazards.	**Use of Equipment and Materials** • selects and uses appropriate equipment/materials in a safe and efficient manner • models the correct use of personal protective equipment • makes accurate calculations and measurements • models proper lifting and handling techniques • fulfills clean-up and maintenance responsibilities • identifies and corrects potential health and safety hazards.
Teamwork • works cooperatively with others in structured settings • shares equipment and supplies	**Teamwork** • cooperates with group members in structured and non-structured settings • shares equipment and work appropriately among group members • negotiates solutions to problems.	**Teamwork** • collaborates and works cooperatively with group members • shares responsibilities among group members • negotiates with sensitivity solutions to problems • displays effective communication skills.

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ASSESSMENT FRAMEWORK: PRODUCT ASSESSMENT

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Planning and Management • identifies product expectations • gathers information from sources provided • generates more than one product idea • selects a product with guidance • makes modifications to pictorial and/or multi-viewed drawings as required using appropriate tools • organizes major events from a prepared list • completes a simple material list and cost estimate	**Planning and Management** • defines product expectations • conducts research pertaining to the selection of a product from a variety of sources • generates and considers the suitability of a number of product ideas • selects an appropriate solution that meet product outcomes • produces and accurately dimensions simple pictorial and multi-viewed drawings where necessary using basic tools and software • determines an appropriate sequence of events to fabricate a product in a safe manner • prepares a list of materials and cost estimate • revises work plan to accommodate changing requirements • estimates the required time to complete a task including planning, set-up and clean-up procedures	**Planning and Management** • determines the product expectations by analyzing performance needs and related issues • generates a variety of different product ideas using available resources and advice from knowledgeable sources • selects a solution that has a high potential for success • produces accurate pictorial and multi-viewed drawings complete with dimensions and notations using the appropriate tools and software • analyzes drawings to determine efficient and safe event sequences • prepares a material estimate from the working drawings • is sensitive to a variety of feedback mechanisms and alters plans when the current approach to task is ineffective • creates a meaningful timeline based on the complexity of the task
Fabrication Techniques (refer to specific module and/or product specifications) **Work Skills** • prepares self for task • follows basic instructions as directed • adheres to prescribed time lines • works cooperatively with others in structured settings • uses prescribed personal protective equipment • follows proper lifting, handling and storage procedures • fulfills given clean-up responsibilities	**Fabrication Techniques** (refer to specific module and/or product specifications) **Work Skills:** • prepares self for task • follows directions with limited prompting • adheres to established timelines • works cooperatively with others in both structured and non-structured settings • uses proper personal protective equipment • observes proper lifting, handling and storage procedures • fulfills expected clean-up responsibilities	**Fabrication Techniques** (refer to specific module and/or product specifications) **Work Skills** • prepares self for task • accurately interprets and follows directions • creates and adheres to detailed timelines • works cooperatively and collaboratively with others • uses appropriate personal protective equipment • models proper lifting, handling and storage procedures • fulfills clean-up and tool maintenance responsibilities
Product Presentation • describes the product and its use • summarizes and reports on major events • evaluates product planning and construction techniques • suggests ways to improve the product	**Product Presentation** • describes the purpose of the product • summarizes and reports on major events • evaluates the design and production techniques • suggests ways to improve product design and production processes	**Product Presentation** • describes the purpose and scope of the product • summarizes and reports on major events • assesses design processes and production techniques • makes recommendations to improve product quality and productivity

ASSESSMENT FRAMEWORK: FABRICATION PROCESS FABPRS

INTRODUCTORY	INTERMEDIATE	ADVANCED
The student:	*The student:*	*The student:*
Preparation and Planning • prepares self for task • adheres to routine procedures • follows basic instructions • asks for help when unsure • reads simple drawings • locates prescribed personal protective equipment (PPE)	**Preparation and Planning** • prepares self for task • organizes and works in an orderly manner • interprets and carries out instructions • thinks through problem before asking for help • identifies proper personal protective equipment (PPE)	**Preparation and Planning** • prepares self for task • develops and effective work plan • interprets and carries out instructions accurately • attempts to solve problems prior to requesting help • determines proper personal protective equipment (PPE) and ventilation requirements
Use of Equipment and Materials: • uses the proper PPE • follows accepted start-up, operation and shut-down procedures • recognizes and reports potential health and safety hazards • follows proper lifting, handling and storage procedures • calculates and measures accurately • fulfills given clean-up responsibilities	**Use of Equipment and Materials:** • uses PPE in an appropriate manner • follows accepted start-up, operation and shut-down procedures • identifies and reports potential health and safety hazards • observes proper lifting, handling and storage procedures • calculates and measures accurately to minimize waste • fulfills expected clean-up responsibilities	**Use of Equipment and Materials:** • uses the correct PPE and engineering controls • follows accepted start-up, operation and shut-down procedures • identifies and corrects potential health and safety hazards • models proper lifting, handling and storage procedures • makes accurate calculations and measurements to meet standards • conserves materials and energy • fulfills clean-up and maintenance responsibilities
Task Performance: (Refer to specific module and learner expectations)	**Task Performance: (Refer to specific module and learner expectations)**	**Task Performance: (Refer to specific module and learner expectations)**

General Outcome

The student will:

- identify and describe the safe use of basic hand tools used in fabricating an artifact or structure

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ follows instruction accurately
☐ responds to directed questions and follows necessary steps to find answers
☐ accesses basic in-school/community information sources
☐ organizes information in a logical manner
☐ records information accurately, using correct technical terms
☐ uses time effectively

Content

☐ develops a chart depicting 20 common hand tools
☐ classifies each tool according to the following categories:
  - measurement and layout tools
  - cutting/boring tools
  - assembly/dismantling tools
  - abrasive tools
☐ describes the purpose and safe use of each tool

Presenting

☐ demonstrates effective use of one or more communication media; e.g.:
  Written: *spelling, punctuation, grammar basic format*
  Oral: *voice projection, body language*
  Audio-visual: *techniques, tools*
☐ uses correct grammatical conventions and technical terms
☐ provides an introduction that describes the purpose of the project
☐ communicates information in a logical sequence

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Content	4 3 2 1 0	1	
Presenting	4 3 2 1 0	1	

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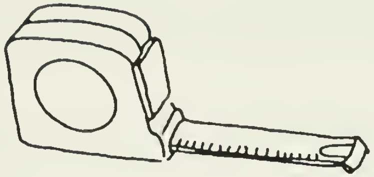
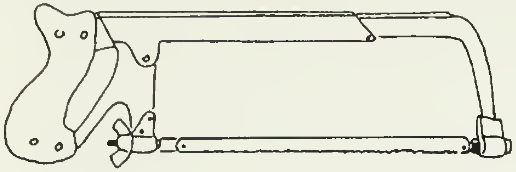
TOOL	CATEGORY	DESCRIPTION
 Measuring Tape	Measurement and Layout Tool	A measuring tape is a spring-loaded steel tape that is carried in a pocket or pouch. It is easy to use and can be purchased in a variety of lengths in both metric and imperial measure. When retracting, care should be taken to avoid contact with the blade.
 Hacksaw	Cutting Tool	A hacksaw is used for straight cuts in metal or plastic. The work piece should be held firmly in place at all times. To avoid blade breakage when cutting thin material, the saw should be held so that at least three teeth are in contact with the material at all times.

For additional sample items and responses, refer to:

- *Design and Technology*. Kathy Browning et. al., 1994. Teacher's Resource.

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General Outcome

The student will:

- identify and compare the properties of common ferrous and nonferrous metals used in fabrication processes

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
- ☐ follows instructions accurately
- ☐ responds to directed questions and follows necessary steps to find answers
- ☐ accesses basic in-school/community information sources
- ☐ organizes information in a logical manner
- ☐ records information accurately, using correct technical terms
- ☐ uses time effectively

Content
- ☐ identifies and compares, in chart form, the properties of:
  - low-, medium- and high-carbon steels
  - alloy steels
  - nonferrous metals and their alloys

Content (continued)
- ☐ provides a sample and description of each material
- ☐ identifies a common use for each material
- ☐ explains different processes used in assembling/fastening each material

Presenting/Reporting
- ☐ demonstrates effective use of one or more communication media; e.g.:
  - Written: *spelling, punctuation, grammar basic format*
  - Oral: *voice projection, body language*
  - Audio-visual: *techniques, tools*
- ☐ uses correct grammatical conventions and technical terms
- ☐ provides an introduction that describes the purpose of the project
- ☐ communicates information in a logical manner

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Content	4 3 2 1 0	1	
Presenting/ Reporting	4 3 2 1 0	1	

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FABRICATION PROCESS: BASIC OXYACETYLENE WELDING — Oxyacetylene Welding: FAB1040–1

General Outcomes

The student will:

- recognize health and safety hazards associated with oxyacetylene welding (OAW), and take preventive measures to avoid accidents and personal injury to self and others
- demonstrate basic oxyacetylene welding competencies

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
- ☐ prepares self for task
- ☐ adheres to routine procedures
- ☐ follows basic instruction
- ☐ asks for help when unsure
- ☐ locates prescribed personal protective equipment (PPE)

Use of Equipment and Materials
- ☐ wears the proper PPE
- ☐ follows accepted start-up, operation and shut-down procedures
- ☐ recognizes potential health and safety hazards
- ☐ follows proper lifting, handling and storage procedures
- ☐ calculates and measures accurately

Use of Equipment and Materials (continued)
- ☐ carries out proper fit-up procedures
- ☐ selects the correct size of tip
- ☐ balances the flame correctly
- ☐ demonstrates good rod and flame manipulation
- ☐ cleans the weld appropriately
- ☐ fulfills given clean-up responsibilities

Task Performance
- ☐ runs lines of fusion with and without filler rod on available mild steel
- ☐ successfully completes lap and tee joint fillet welds in the flat position using available light gauge mild steel

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Use of Equipment and Materials	4 3 2 1 0	1	
Task Performance	4 3 2 1 0	1	

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Module Learner Expectation

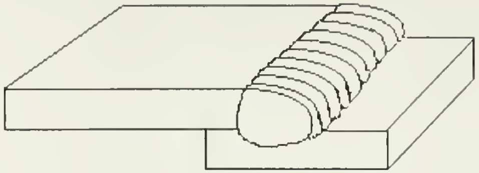
The student will:

- demonstrate basic oxyacetylene welding competencies

PROCEDURE

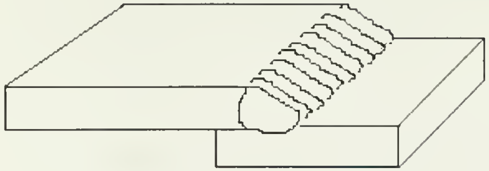
Weld Type:	Lap Joint Fillet Weld
Position:	flat
Base Metal	2 – 1 ½" x 4" (38 mm x 100 mm) 10–16 ga. mild steel
Preparation:	scale and burrs removed, tight-fitting joint tacked at both ends with minimum plate overlap
Filler Metal:	R.G. 60; diameter appropriate to thickness of base metal (3/32"–5/32")
Tip:	appropriate to filler metal and base metal thickness
Manipulation:	forehand with torch inclination of 45° to 60°

Task Performance Appraisal



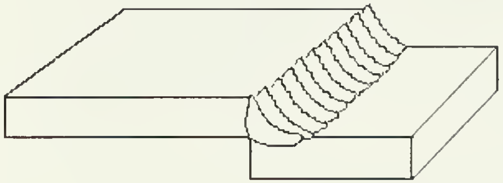
Desirable Fillet Weld

Beads are slightly convex and have good penetration and strength.



Defective Fillet Weld

Evidence of melt back on top corner and overlap on bottom plate. Weak joint because of poor penetration, melt back and overlap.



Defective Fillet Weld

Weld is concaved and lacks penetration. Weak joint because of root size, insufficient throat and poor preparation.

Module Learner Expectations

The student will:

- recognize health and safety hazards associated with electric welding processes, and preventive measures to avoid accidents and personal injury to self and others
- demonstrate basic arc welding competencies

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

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0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
- ☐ prepares self for task
- ☐ adheres to routine procedures
- ☐ follows basic instruction
- ☐ asks for help when unsure
- ☐ locates prescribed personal protective equipment (PPE)

Use of Equipment and Materials
- ☐ wears the proper PPE
- ☐ follows accepted start-up, operation and shut-down procedures
- ☐ recognizes potential health and safety hazards
- ☐ follows proper lifting, handling and storage procedures
- ☐ calculates and measures accurately
- ☐ carries out proper fit-up procedures
- ☐ selects specified filler material

Use of Equipment and Materials (continued)
- ☐ adjusts the equipment as directed
- ☐ manipulates the electrode/gun at the correct angle and inclination as directed
- ☐ removes slag and cleans beads and welds appropriately
- ☐ stores and disposes materials as instructed
- ☐ fulfills given clean-up responsibilities

Task Performance
- ☐ successfully completes stringer and weave beading on available mild steel in the flat and vertical position using E6013 (E41013) and E7014 (E48014) electrodes
- ☐ successfully completes fillet welds on available mild steel in the flat and horizontal positions using GMAW and/or SMAW processes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Use of Equipment and Materials	4 3 2 1 0	1	
Task Performance	4 3 2 1 0	1	

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ILLUSTRATIVE EXAMPLE: FLAT LAP JOINT FILLET WELD

Module Learner Expectation

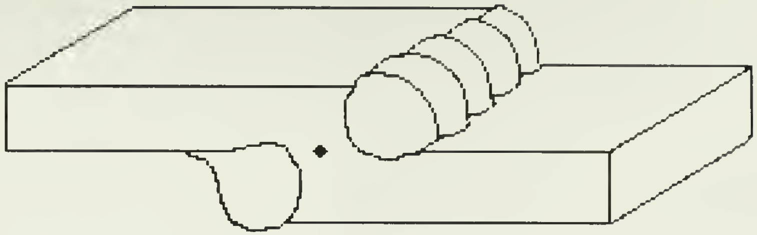
The student will:

- demonstrate basic arc welding competencies

PROCEDURE

Weld Type:	Lap Joint Fillet Weld (GMAW)
Position:	flat
Base Metal:	2 – 1½" x 6" (38 mm x 150 mm) 10–14 gauge mild steel
Preparation:	wire brush to remove rust, oil and scale
Filler Material:	0.035" (0.9 mm) ER70S
Shielding Gas	CO_2
Number of Passes:	one
Machine Set-up:	as recommended by the manufacturer
Fit-up:	3/8" (10 mm) overlap, tight fitting tacked at both ends.
Manipulation:	weld both sides of joint. Electrode angle 45° with an inclination of 15° forehand.

Task Performance Appraisal



Desirable Weld

Beads should be straight and slightly convex with evenly spaced bullet shaped ripples. Both legs of the fillet weld should be of equal length. There should be very little evidence of porosity, undercutting, coldlapping or spatter. Complete fusion should exist between the bead and the base metal

Acceptable Weld

Weld profile should be convex with a minimum amount of porosity, spatter, undercutting and coldlapping. Good fusion should exist between the bead and base metal.

Comments:

PRODUCT ASSESSMENT: WORKING WITH SHEET STOCK

Sheet Fabrication 1: FAB1090–1

Module Learner Expectations

The student will:

- demonstrate basic measurement and layout skills and techniques
- apply basic sheet stock fabrication skills and techniques to produce a product

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ defines product requirement
☐ gathers background information from sources provided
☐ generates one or more product idea
☐ produces/modifies simple pictorial and or multi-viewed sketch or drawing as required
☐ provides accurate dimensions and notes
☐ completes a simple materials list and cost estimate
☐ creates a logical sequence of events

Fabrication Techniques
☐ prepares a pattern or template to transfer cutting and folding lines
☐ calculates and measures accurately
☐ cuts, bends and assembles according to plan
☐ applies a suitable finish and or surface detail

Work Skills
☐ follows instructions as directed
☐ adheres to prescribed time line
☐ works cooperatively with others in structured settings
☐ uses prescribed personal protective equipment
☐ fulfills given clean-up responsibilities
☐ follows proper lifting, handling and storage procedures

Product Presentation
☐ describes the product and its use
☐ summarizes and reports on major events
☐ evaluates product planning and fabrication techniques
☐ suggests ways to improve the product

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Fabrication Techniques	4 3 2 1 0	1	
Work Skills	4 3 2 1 0	1	
Product Presentation	4 3 2 1 0	1	

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Module Learner Expectation

The student will:

- identify and describe the principles of separating, forming and combining materials

Standard

Response rating of 1.

Rating Scale

The student:

4 independently makes explanations, critical judgements based on a superior knowledge base and understanding of content and related issues.

3 makes explanations and comparisons of content using more precise terminology. Requires little or no prompting.

2 applies knowledge of content to different situations using accurate terminology. May require some prompting.

1 relies on simple recall to demonstrate basic knowledge and understanding of content. May require frequent prompting.

0 is unable to provide a suitable response at this time.

Sample Questions Item(s)	Sample Response(s)
1. Identify and describe three basic processes used to fabricate materials.	1. Separating: Separating is a process of changing the size and shape of an object by removing materials usually by means of a chipping or shearing action. Combining: Combining is a process used to mix materials together or to join one material to another by using mechanical fasteners or bonding agents. Forming: Forming is a process of changing the size and shape of a material without adding or taking away material as in bending and casting.
2. List three ways of combining metal parts.	2. Metal parts can be combined using mechanical fasteners such as bolts, screws and rivets. Other processes include welding (cohesive) and soldering (adhesive) processes.
3. Give an example of a: – permanent – semi-permanent – temporary fastening system	3. Welding two parts together is an example of a permanent procedure. Parts cannot be taken apart without cutting. Riveting is a semi-permanent process. They can be removed by drilling or by cutting and punching. Temporary fasteners such as screws and bolts can be removed relatively easily using a screwdriver or wrench.

For additional sample items and responses refer to:

- *Production Technology.* Stanley A. Domacek, 1993. Text.
- *Technology Shaping Our World.* John Gradwell et. al., 1996. Text and Instructor's Manual.

ISSUE ANALYSIS: FASTENING SYSTEMS — Fabrication Principles: FAB1100–2

Module Learner Expectation

The student will:

- describe the characteristics and give examples of permanent, semipermanent and temporary fastening systems

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ describes an issue on which people agree/disagree on the use of one or more fastening systems
☐ poses one or more questions regarding advantages/disadvantages of one fabrication technique over another
☐ accesses basic in-school/community information sources regarding the issue(s)
☐ uses one or more information-gathering techniques

Analyzing Perspectives
☐ clarifies different points of view regarding the:
- serviceability
- strength
- appearance
- ease of use
- cost of production of various fastening systems

Analyzing Perspectives (continued)
☐ states a position on the issue and logical reasons for adopting that position
☐ states an opposing position on the issue and logical reasons for adopting that position
☐ identifies source of conflict among different positions
☐ distinguishes between fact and fiction/opinion/theory

Evaluation Choices/Making Decisions
☐ identifies useful alternative fastening systems for a given application
☐ selects an appropriate fastening system for a specific application
☐ reflects on strengths/weaknesses of a particular choice
☐ communicates information in a logical sequence to justify choices/decisions.

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Analyzing Perspectives	4 3 2 1 0	1	
Evaluation Choices/Making Decisions	4 3 2 1 0	1	

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PRESENTATIONS/REPORTS: BAR AND TUBULAR STOCK

Bar & Tubular Fabrication: FAB1110–1

Module Learner Expectation

The student will:

- list and describe common shapes and sizes of bar and tubular stock

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ follows instructions accurately
☐ responds to directed questions and follows necessary steps to find answers
☐ accesses basic in-school/community information sources
☐ organizes information in a logical manner
☐ records information accurately using correct technical terms
☐ uses time effectively

Content

☐ identifies in chart form, common bar and tubular forms such as:
- angle stock
- round stock
- square stock
- hexagonal stock
- flat bars
- round tubes
- square tubes
- rectangular tubes

Content (continued)

☐ lists common sizes for each type of stock
☐ provides one application/use for each of the identified materials

Presenting/Reporting

☐ demonstrates effective use of one or more communication media:
e.g., *Written:* *spelling, punctuation, grammar, basic format*
Oral: *voice projection, body language*
*Audio-visual**: techniques, tools*
☐ uses correct grammatical conventions and technical terms
☐ provides an introduction that describes the purpose of the project
☐ communicates information in a logical sequence

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING					STANDARD	COMMENTS
Preparation and Planning	4	3	2	1	0	1	
Content	4	3	2	1	0	1	
Presenting/ Reporting	4	3	2	1	0	1	

PRODUCT ASSESSMENT: WORKING WITH BAR STOCK

Bar & Tubular Fabrication: FAB1110–2

Module Learner Expectations

The student will:

- demonstrate approved material handling and storage practices
- apply basic bar and tubular fabrication skills and techniques to produce a product

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ defines product requirement
☐ gathers background information from sources provided
☐ generates one or more product ideas
☐ produces/modifies simple pictorial and or multiviewed sketches or drawings as required
☐ provides accurate dimensions and notes
☐ completes a simple materials list and cost estimate

Fabrication Techniques
☐ calculates and measures accurately, e.g., bend allowances
☐ uses the appropriate tools to accurately:
  - layout and mark stock
  - cut stock to length
  - bend arcs and angles
☐ assembles and finishes according to the product plan

Work Skills
☐ follows instructions as directed
☐ adheres to prescribed timeline
☐ works cooperatively with others in structured settings
☐ uses prescribed personal protective equipment
☐ fulfills given clean-up responsibilities
☐ follows proper lifting, handling and storage procedures
☐ stores, and/or disposes of materials as instructed

Product Presentation
☐ describes the product and its use
☐ summarizes and reports on major events
☐ assesses the design and production processes
☐ suggests possible improvements

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Fabrication Techniques	4 3 2 1 0	1	
Work Skills	4 3 2 1 0	1	
Product Presentation	4 3 2 1 0	1	

PRODUCT ASSESSMENT: SAND CASTING

Foundry 1: FAB1120–1

Module Learner Expectations

The student will:

- recognize health and safety hazards associated with casting metal, and take preventive measures to avoid accidents and personal injury to self and others
- demonstrate basic pattern making skills to make a one-piece mold
- demonstrate basic sand casting skills, using a one-piece pattern

Standard

Performance rating of 1 or as stated for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
- ☐ defines product requirement
- ☐ gathers background information from sources provided
- ☐ generates one or more product ideas
- ☐ produces/modifies simple pictorial and or multiviewed sketches or drawings as required
- ☐ provides accurate dimensions and notes

Fabrication Techniques
- ☐ calculates and measures accurately
- ☐ prepares a one-piece pattern according to plan
- ☐ uses the appropriate tools and materials to prepare a sand mold
- ☐ packs and vents the mold sufficiently
- ☐ pours and finishes the casting according to plan

Work Skills
- ☐ follows instructions as directed
- ☐ adheres to prescribed timeline
- ☐ works cooperatively with others in structured settings
- ☐ uses prescribed personal protective equipment
- ☐ fulfills given clean-up responsibilities
- ☐ follows proper heating and pouring techniques
- ☐ stores, and/or disposes of materials as instructed

Product Presentation
- ☐ describes the product and its use
- ☐ summarizes and reports on major events
- ☐ assesses the design and production processes
- ☐ suggests possible improvements

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Fabrication Techniques	4 3 2 1 0	1	
Work Skills	4 3 2 1 0	1	
Product Presentation	4 3 2 1 0	1	

RESPONSE ASSESSMENT: MACHINING MATERIALS AND PROCESSES

Principles of Machining: FAB1130–1

Module Learner Expectation

The student will:

- identify and describe common machinable materials and machining processes

Standard

Response rating of 1.

Rating Scale

The student:

4 independently makes explanations, critical judgements based on a superior knowledge base and understanding of content and related issues.

3 makes explanations and comparisons of content using more precise terminology. Requires little or no prompting.

2 applies knowledge of content to different situations using accurate terminology. May require some prompting.

1 relies on simple recall to demonstrate basic knowledge and understanding of content. May require frequent prompting.

0 is unable to provide a suitable response at this time.

Sample Questions Item(s)	Sample Response(s)
1. Identify and describe one machinable material for each one of the following categories of materials: a) ferrous metal b) nonferrous metal c) plastic	Ferrous Metal - Mild Steel: Mild steel is a relatively soft steel that can be machined into parts that do not require great strength Nonferrous Metal - Aluminium: Pure aluminium is too soft for most uses. Other elements such as copper, zinc and magnesium, when added to pure aluminium, greatly improve its machining properties. Plastic - acrylic: Most acrylic stock can be machined. Because acrylic plastic is quite brittle, care must be taken not to chip this material when cutting or drilling.
2. List three common machining processes and give one or more examples of a machine tool for each process.	Turning: – Manually operated lathe – Numerically controlled lathe Drilling: – Portable electric drill – Bench/post drill press Abrading: – Portable electric grinder – Bench/pedestal grinder
3. What are three variables that must be taken into consideration when machining a given material?	Three variables are: – cutting speed – feed rate – depth of cut

For additional sample items and responses refer to:

- *Metal Work Technology and Practice*. Victor E. Repp, 1994. Text and Student Work Book

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Module Learner Expectation

The student will:

- demonstrate basic hand and machine tool knowledge, skills and techniques

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ defines product requirement
☐ gathers background information from sources provided
☐ generates one or more product ideas
☐ produces/modifies simple pictorial and or multiviewed sketches or drawings as required
☐ provides accurate dimensions and notes
☐ identifies basic machining operations
☐ determines a logical sequence of machining operations

Fabrication Techniques
☐ uses the appropriate tools and processes to accurately:
  - measure and mark stock
  - cut stock to length
  - drill, turn and grind safely
  - finish and assemble to plan

Work Skills
☐ follows instructions as directed
☐ adheres to prescribed timeline
☐ works cooperatively with others in structured settings
☐ uses recommended personal protective equipment
☐ fulfills given clean-up responsibilities
☐ follows proper lifting, handling and storage procedures

Product Presentation
☐ describes the product and its use
☐ summarizes and reports on major events
☐ assesses the design and production processes
☐ suggests possible improvements

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Fabrication Techniques	4 3 2 1 0	1	
Work Skills	4 3 2 1 0	1	
Product Presentation	4 3 2 1 0	1	

PRESENTATIONS/REPORTS: PLANNING A PRODUCTION SYSTEM — Production Systems: FAB1160–1

Module Learner Expectations

The student will:

- list and describe common methods of manufacturing durable products
- demonstrate basic production planning and management skills
- identify the present and future career opportunities related to the production of durable products

Standard

Performance rating of 1 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ follows instructions accurately
☐ responds to directed questions and follows necessary steps to find answers
☐ accesses basic in-school/community information sources
☐ organizes information in a logical manner
☐ records information accurately using correct technical terms
☐ uses time effectively

Content

☐ lists and describes 4 different manufacturing systems, e.g.:
  - custom
  - pre-fabrication
  - job-lot
  - just-in-time

☐ develops a plan for a production run by:
  - describing the system
  - creating production flowchart
  - listing resources and equipment requirements

Content (continued)

☐ describes career opportunities related to manufacturing
☐ outlines skill and training requirements for one occupation or related trade

Presenting/Reporting

☐ demonstrates effective use of one or more communication media:
e.g., *Written**: spelling, punctuation, grammar, basic format*
*Oral**: voice projection, body language*
*Audio-visual**: techniques, tools*

☐ uses correct grammatical conventions and technical terms
☐ provides an introduction that describes the purpose of the project
☐ communicates information in a logical sequence

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	1	
Content	4 3 2 1 0	1	
Presenting/ Reporting	4 3 2 1 0	1	

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Module Learner Expectations

The student will:

- list and describe the principal characteristics of all structures
- identify strategies to improve the efficiency of a structure
- apply principles of structural design to fabrication and construction activities

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ follows instructions accurately
☐ responds to directed questions and follows necessary steps to find answers
☐ accesses basic in-school/community information sources
☐ organizes information in a logical manner
☐ records information accurately using correct technical terms
☐ uses time effectively

Content

☐ provides evidence that:
- structures found in the constructed world share common elements and principles found in nature
- structural elements provide both shape and support to the structure; e.g., shell, frame
- forces are dispersed throughout the structure
- forces must be kept in balance to prevent the structure from failing

☐ describes the effects of the following forces on a structure:
- compression
- tension
- shear
- bending
- twisting

Investigating

☐ designs and builds an appropriate structure to be tested
☐ tests the load-carrying capability of the structure
☐ analyzes the test results in terms of:
- strength to weight ratio
- cost effectiveness

☐ lists strategies to improve the efficiency of the structure

Presenting/Reporting

☐ demonstrates effective use of one or more communication media:
e.g., Written: spelling, punctuation, grammar, basic format
Oral: voice projection, body language
Audio-visual: techniques, tools

☐ uses correct grammatical conventions and technical terms
☐ provides an introduction that describes the purpose of the project
☐ communicates information in a logical sequence

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Investigating	4 3 2 1 0	2	
Presenting/Reporting	4 3 2 1 0	2	

Module Learner Expectations

The student will:

- identify and describe the principal components of a print
- demonstrate basic print reading skills

Standard

Response rating of 2.

Rating Scale

The student:

4 independently makes explanations, critical judgements based on a superior knowledge base and understanding of content and related issues.

3 makes explanations and comparisons of content using more precise terminology. Requires little or no prompting.

2 applies knowledge of content to different situations using accurate terminology. May require some prompting.

1 relies on simple recall to demonstrate basic knowledge and understanding of content. May require frequent prompting.

0 is unable to provide a response at this time.

Sample Questions Item(s)	Sample Response(s)
1. On a given drawing, identify the following lines: a) object lines b) dimension c) centre lines d) hidden lines	
2. What three views are most commonly used to describe an object on a working drawing?	The three views commonly found on a working drawing are: – front – top – right side
3. Explain the difference between unilateral and bilateral tolerances.	A bilateral tolerance may vary from a larger size (+) to a smaller size (–) whereas a unilateral tolerance is in one direction only, either (+) or (-).
4. Provide an example of a symbol used in a typical: – electrical – machining – welding – architectural drawing	
5. Given a working drawing, determine: – internal and external dimensions – types of materials and finishes – types of fit and tolerances – fabrication processes	

For additional sample items and responses refer to:

- *Basic Blueprint Reading and Sketching*. C. Thomas Olivo, 1993. Text

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Module Learner Expectations

The student will:

- describe the essential differences between braze welding and fusion welding
- demonstrate basic braze welding competencies
- demonstrate basic oxyfuel weld (OFW) competencies in the flat, horizontal and vertical positions

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ interprets and carries out instructions
☐ understands the important differences between fusion and braze welding
☐ describes visible indicators of correct metal temperatures for braze welding
☐ reads weld specifications to determine:
  - weld type and position
  - size and thickness of components
  - tip size and filler metal
  - welding techniques
☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures

Use of Equipment and Materials (continued)

☐ measures accurately
☐ carries out proper fit-up procedures
☐ selects appropriate tip
☐ balances the flame correctly
☐ demonstrates good rod and flame manipulation
☐ recognizes potential health and safety hazards
☐ stores and disposes of materials as instructed
☐ fulfills given clean-up responsibilities

Task Performance

☐ produces two or more acceptable braze weld applications
☐ produces two or more acceptable fusion square groove butt and fillet welds in the flat, horizontal and vertical position using available light and heavy gauge mild steel.

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Task Performance	4 3 2 1 0	2	

ILLUSTRATIVE EXAMPLE: VERTICAL BUTT JOINT FUSION WELD

Oxyfuel Welding: FAB2030–2

Module Learner Expectation

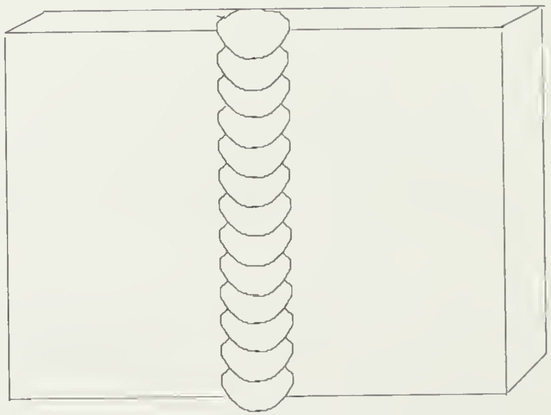
The student will:

- demonstrate basic oxyfuel welding (OFW) competencies in the flat, horizontal and vertical positions

PROCEDURE

Weld Type:	Butt Joint Fusion Weld (OFW)
Positions:	vertical
Base Metal:	2 – 2" x 5" (50 mm x 125 mm) 10 or 11 gauge mild steel
Preparation:	cut to size, remove burr and tack ends
Filler Metal:	3/32" M.S. filler rod – RG-60
Equipment Set-up:	#3 tip, neutral flame, mid range
Fit-up:	1/8" (3 mm) gap
Manipulation:	torch angle, ½ included angle with tip inclination of 5°–15° off 90° in the vertical position

Task Performance Appraisal



Desirable Weld

Weld profile should be slightly convex and of uniform width and height. Ripples are to be close, bullet shaped and free of voids, evidence of undercutting and overlapping. Good depth of penetration should be evident over the entire length of the weld.

Acceptable Weld

Weld profile should be slightly convex with evenly spaced ripples. Evidence of undercutting and overlapping should be minimal. Adequate depth of penetration should be evident over the length of the weld.

Comments:

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FABRICATION PROCESS: BASIC ARC WELDING — Arc Welding 1: FAB2050–1

Module Learner Expectations

The student will:

- identify the appropriate treatment for minor injuries associated with welding processes
- describe the visual characteristics of a desirable weld
- demonstrate basic SMAW competencies in the flat position

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ thinks through problems before asking for help
☐ reads weld specification to determine:
  - weld type and position
  - type of weldment
  - type of electrode
  - equipment settings
  - welding techniques

☐ understands first aid treatment for minor cuts, burns and bruises
☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes potential health and safety hazards
☐ measures accurately

Use of Equipment and Materials (continued)

☐ carries out proper fit-up procedures
☐ selects the correct electrodes
☐ adjusts equipment according to the weld specification
☐ manipulates the electrode as instructed
☐ removes slag and cleans weld appropriately
☐ stores and disposes materials as instructed
☐ fulfills given clean-up responsibilities

Task Performance

☐ produces two or more acceptable:
  - single and multi-pass flat lap joints on available mild steel using E6010 (E41010) and E7014 (E48014) filler metal
  - single and multi-pass butt joints on available mild steel using E6010 or 11 (E41010/11) and E7018 (E48018) electrodes

☐ evaluates a given weld according to:
  - overall appearance of beads
  - weld profile
  - plate penetration
  - degree of undercutting and overlapping
  - slag inclusion

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Task Performance	4 3 2 1 0	2	

ILLUSTRATIVE EXAMPLE: FLAT LAP JOINT FILLET WELD

Module Learner Expectation

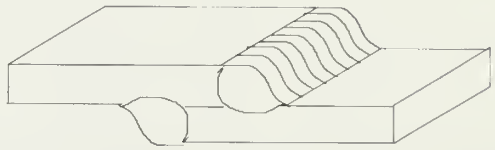
The student will:

- demonstrate basic SMAW competencies in the flat position

PROCEDURE:

Weld Type:	Lap Joint Fillet Weld
Positions:	flat
Preparation:	wire brush to remove rust, oil and scale
Base Metal:	2 –3/8" x 1½" x 5" (5 mm x 38 mm x 125 mm) mild steel
Filler Material:	1/8" E6010 (E41010) electrodes
Number of Passes:	one
Machine Set-up:	DCRP 90–120 amps
Fit-up:	¼" overlap, tight joint tacked at both ends
Manipulation:	one pass, stringer bead; electrode angle ½ of included joint angle and electrode inclination 5°–30° backhand, weld both sides.

Task Performance Appraisal



Desirable Weld

Weld profile should be slightly convex and of uniform width and height. Ripples are to be close, bullet shaped and free of voids, slag inclusion, high spots, craters and apparent restarts. Good plate penetration should exist over the entire length of the weld.

Acceptable Weld

Weld profile should be slightly convex with uniformly spaced ripples. Evidence of undercutting and overlapping should be minimal. Adequate fusion should exist between the bead and base metal.

Comments:

RESPONSE ASSESSMENT: ELECTRODE CODING — Arc Welding 2: FAB2060–1

Module Learner Expectation

The student will:

- explain the current systems used to classify electrodes in Canada and the United States

Standard

Response rating of 2.

Rating Scale

The student:

4	independently makes explanations, critical judgements based on a superior knowledge base and understanding of content and related issues.
3	makes explanations and comparisons of content using more precise terminology. Requires little or no prompting.
2	applies knowledge of content to different situations using accurate terminology. May require some prompting.
1	relies on simple recall to demonstrate basic knowledge and understanding of content. May require frequent prompting.
0	is unable to provide a suitable response at this time.

Sample Question Item(s)	Sample Response(s)
1. What is the difference between the CSA and AWS electrode coding systems?	The essential difference between the CSA and AWS coding system is that the CSA uses megapascals whereas the AWS uses pounds per square inch to indicate the tensile strength of an electrode.
2. Explain the meaning of the following electrode code: – CSA - E-48014 – AWS - E-7024	E – Electrode 480 – tensile strength (480,000 M Pa) 1 – Weld Position 4 – AC and DC (straight and reverse polarity and flux characteristics)
3. Given the following electrodes to choose from, – E6013 (E41013) – E6018 (E41018) – E6012 (E41012) – E6011 (E41011) which one will provide: a) for general purpose work with poor fit up, produces medium penetration and slag b) for good quality general purpose work, produces heavy slag, medium penetration c) produces deep penetration and light slag, can also be used with AC d) good penetration, good for low alloy and mild steel.	a) E6012 b) E6013 c) E6011 d) E6018

For additional sample items and responses refer to:

- *Welding Technology Fundamentals*. William A. Bowditch, 1991. Text and Laboratory Manual.
- *Modern Welding*. Andrew D. Althouse et. al., 1992. Text and Laboratory Manual.

Module Learner Expectations

The student will:

- identify strategies to assess and improve weld quality
- demonstrate basic shielded metal arc welding (SMAW) competencies in the horizontal position

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ thinks through problems before asking for help
☐ reads weld specification to determine:
  - weld type and position
  - type of weldment
  - type of electrode
  - equipment settings
  - welding techniques
☐ lists variables that contribute to weld quality
☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes potential health and safety hazards

Use of Equipment and Materials (continued)

☐ measures accurately
☐ carries out proper fit-up procedures
☐ selects the correct electrodes
☐ adjusts equipment according to the weld specification
☐ manipulates the electrode as instructed
☐ removes slag and cleans weld appropriately
☐ stores and disposes materials as instructed
☐ fulfills given clean-up responsibilities

Task Performance

☐ produces two or more acceptable single and multi-pass horizontal:
  - lap joints using available mild steel and E7014 (E48014) and E7018 (E48018) electrodes
  - tee joints using available mild steel and E6010(41010) and/or E7024 (E48024) electrodes
☐ analyzes a given weld and takes appropriate measures to improve weld quality

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Task Performance	4 3 2 1 0	2	

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ILLUSTRATIVE EXAMPLE: HORIZONTAL TEE JOINT – SINGLE PASS

Module Learner Expectation

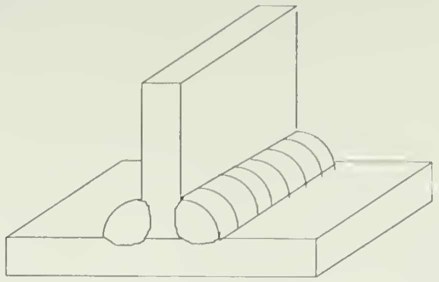
The student will:

- demonstrate basic shielded metal are welding (SMAW) competencies in the horizontal position

Procedure

Weld Type:	Tee Joint Fillet Weld
Position:	horizontal
Preparation:	cut plates to 5" (125 mm) and wire brush joint
Base Metal:	1 – 3/8" x 2" x 5" (10 mm x 50 mm x 125 mm) 1 – 3/8" x 1 1/2" x 5" (10 mm x 38 mm x 125 mm) mild steel plate
Filler Metal:	5/32" E6010 (E41010)
Number of Passes:	one
Machine Set-up:	AC or DCRP, 180–200 amps
Fit-up:	centre tee section, tack at ends
Manipulation:	electrode angle ½ angle of included joint angle with an inclination of 10°–30° backhand.

Task Performance Appraisal



Desirable Weld

Beads should be slightly convex and have uniformly spaced, bullet shaped ripples. Restarts are made without creating depressions or high spots. Evidence of slag inclusion, undercutting and overlapping should not be present. Both legs should be equal to the material thickness.

Acceptable Weld

Beads should be slightly convex and evenly spaced. Evidence of slag inclusion, undercutting and overlapping should be minimal. Legs should not be less that the thicknesses of the base metal.

Comments:

PRESENTATIONS/REPORTS: ADVANTAGES OF GAS METAL ARC WELDING

Gas Metal Arc Welding 1: FAB2070–1

Module Learner Expectation

The student will:

- outline the advantages and disadvantages of gas metal arc welding versus other forms of arc welding processes

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ sets goals and describes steps to achieve them
☐ uses personal initiative to formulate questions and find answers
☐ accesses a range of relevant in-school/community information sources
☐ interprets, organizes and combines information into logical sequence
☐ records information accurately with appropriate supporting detail and uses correct technical terms
☐ plans and uses time effectively

Content

☐ describes the equipment and process of gas metal arc welding
☐ lists four advantages of GMAW; e.g.:
- welding is continuous, thus much faster
- minimum weld clean-up
- can be used with ferrous and non ferrous materials
- produces less heat affected zone
- lends itself to automation

Content (continued)

☐ lists three disadvantages of GMAW; e.g.:
- shielded gas can be blown away in windy conditions
- greater chance for a 'cold' weld (lack of fusion)
- maintenance costs of equipment are higher

Presenting/Reporting

☐ demonstrates effective use of one or more communication media:

e.g., *Written: spelling, punctuation grammar, basic format*
Oral: voice projection, language
Audio-visual: techniques, tools

☐ uses correct grammatical conventions and technical terms
☐ provides an introduction that describes the purpose of the project
☐ communicates information in a logical sequence

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Presenting/ Reporting	4 3 2 1 0	2	

FABRICATION PROCESS: LIGHT GUAGE FILLET WELDS — Gas Metal Arc Welding 1: FAB2070–2

Module Learner Expectations

The student will:

- identify health and safety hazards associated with gas metal are welding, and take preventive measures to avoid accidents and personal injury to self and others
- demonstrate gas metal arc welding competencies on light gauge mild steel in the flat and horizontal positions

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ thinks through problems before asking for help
☐ reads weld specifications to determine:
  - weld type and position
  - type of weldment
  - type of filler metal
  - equipment settings
  - welding techniques
☐ understands first aid treatment for minor cuts, burns and bruises
☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes potential health and safety hazards

Use of Equipment and Materials (continued)

☐ measures accurately
☐ carries out proper fit-up procedures
☐ selects the correct type of electrode and wire gauge
☐ adjusts equipment according to the weld specification and manufacturer's recommendations
☐ manipulates the gun and electrode as instructed
☐ cleans weld appropriately
☐ stores and disposes materials as instructed
☐ fulfills given clean-up responsibilities

Task Performance

☐ produces two or more acceptable:
  - lap joints on available light gauge mild steel in the horizontal and vertical positions
  - tee joints on available light gauge mild steel in the horizontal and vertical positions
☐ evaluates a given weld according to:
  - overall appearance
  - weld profile
  - plate penetration
  - degree of undercutting and coldlapping
  - slag inclusions if using flux core wire

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Task Performance	4 3 2 1 0	2	

ILLUSTRATIVE EXAMPLE: VERTICAL LAP JOINT FILLET WELD

Gas Metal Arc Welding 1: FAB2070–3

Module Learner Expectation

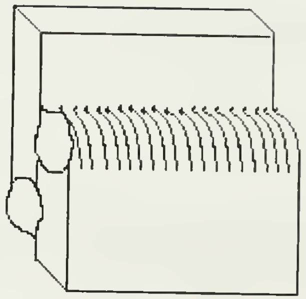
The student will:

- demonstrate gas metal arc welding competencies on light gauge mild steel in the flat and horizontal positions

PROCEDURE

Weld Type:	Lap Joint Fillet Weld
Position:	horizontal
Base Metal:	2 – 1 1/2" x 6" (38 mm x 150 mm) 10–14 gauge mild steel
Preparation:	wire brush to remove rust, oil and scale
Filler Metal:	0.035" (0.9 mm) ER7OS
Shielding Gas	CO_2
Number of Passes:	one
Machine Set-up:	as recommended by manufacturer
Fit-up:	overlap 1/8" (3 mm) tight fitting, tacked at both ends
Manipulation:	weld both sides of joint. Forehand first side and backhand second side.

Task Performance Appraisal



Desirable Weld

Beads should be slightly convex and of uniform width and height. Ripples are to be close, bullet shaped and free of voids, high spots, undercutting and cold lapping. Both legs should be equal to the thickness of the base metal.

Acceptable Weld

Beads should be slightly convex and evenly spaced. Evidence of voids, undercutting and cold lapping should be minimal. Legs should not be less than the thickness of the base metal.

Comments:

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PRODUCT ASSESSMENT: BASIC SHEET METAL PRODUCTS

Module Learner Expectations

The student will:

- identify and describe common types of stock sheet metal materials and related tools
- demonstrate approved materials handling and storage practices
- perform basic sheet metal fabrication skills and practices to produce a product

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help

☐ **Content**
☐ identifies 4 or more different types of sheet metal materials
☐ explains how thicknesses are measured and stated
☐ identifies ten common sheet metal tools and joints
☐ describes three or more types of hems and/or seams

Fabrication Techniques
☐ calculates hem and seam allowances
☐ lays out, cuts, bends and fastens two or more different seams that can be incorporated into a useful product

Work Skills
☐ prepares self for task
☐ follows directions with limited prompting
☐ adheres to established timelines
☐ minimizes material costs
☐ works cooperatively with others in both structured and non-structured settings
☐ uses proper personal protective equipment
☐ observes proper lifting, handling and storage procedures
☐ fulfills expected clean-up responsibilities

Product Presentation
☐ describes the purpose of the product
☐ summarizes and reports on major events
☐ evaluates the design and production techniques
☐ suggests way to improve product design and production processes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Fabrication Techniques	4 3 2 1 0	2	
Work Skills	4 3 2 1 0	2	
Product Presentation	4 3 2 1 0	2	

PRODUCT ASSESSMENT: PARALLEL LINE DEVELOPMENTS

Module Learner Expectations

The student will:

- describe and give examples of parallel line developments
- create a parallel line development, using standard drawing and layout practices
- apply sheet metal fabrication principles skills to fabricate a product, using parallel line development

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

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1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help

☐ **Content**
☐ lists examples of parallel line and radial line developments
☐ compares procedures to lay out parallel line and other developments
☐ identifies common joints and edge treatments associated with parallel line development

Fabrication Techniques
☐ prepares a parallel line development
☐ transfers patterns to sheet stock
☐ cuts, bends and fastens stock according to plan and accepted practice

Work Skills
☐ prepares self for task
☐ follows directions with limited prompting
☐ adheres to established timelines
☐ minimizes material waste
☐ works cooperatively with others in both structured and non-structured settings
☐ uses proper personal protective equipment
☐ observes proper lifting, handling and storage procedures
☐ fulfills expected clean-up responsibilities

Product Presentation
☐ describes the purpose of the product
☐ summarizes and reports on major events
☐ evaluates the design and production techniques
☐ suggests ways to improve product design and production processes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Fabrication Techniques	4 3 2 1 0	2	
Work Skills	4 3 2 1 0	2	
Product Presentation	4 3 2 1 0	2	

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Module Learner Expectations

The student will:

- identify health and safety hazards associated with metal forging, and take preventive measures to avoid accidents and personal injury to self and others
- identify and describe the basic tools and processes used in forging
- demonstrate basic metal forging skills and practices

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help

Content
☐ identifies the parts and describes the safe operation of a forge
☐ describes and demonstrates the processes of drawing, tapering, bending and upsetting
☐ compares the purpose and process of hardening, tempering, annealing and normalizing

Fabrication Techniques
☐ forges a product to the desired size and shape
☐ finishes and conditions the product to achieve the specified properties

Work Skills
☐ prepares self for task
☐ follows directions with limited prompting
☐ adheres to established timelines
☐ minimizes material waste
☐ works cooperatively with others in both structured and nonstructured settings
☐ uses proper personal protective equipment
☐ observes proper lifting, handling and storage procedures
☐ fulfills expected clean-up responsibilities

Product Presentation
☐ describes the purpose of the product
☐ summarizes and reports on major events
☐ evaluates the design and production techniques
☐ suggests ways to improve product design and production processes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Fabrication Techniques	4 3 2 1 0	2	
Work Skills	4 3 2 1 0	2	
Product Presentation	4 3 2 1 0	2	

Module Learner Expectation

The student will:

- describe the essential similarities and differences between a one-piece pattern and a split pattern

Standard

Response rating of 2.

Rating Scale

The student:

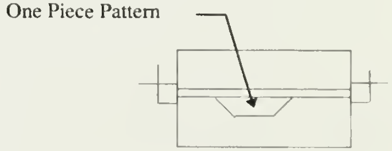
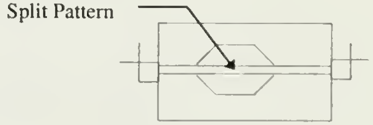
4 independently makes explanations, critical judgements based on a superior knowledge base and understanding of content and related issues.

3 makes explanations and comparisons of content using more precise terminology. Requires little or no prompting.

2 applies knowledge of content to different situations using accurate terminology. May require some prompting.

1 relies on simple recall to demonstrate basic knowledge and understanding of content. May require frequent prompting.

0 is unable to provide a suitable response at this time.

Sample Question Item(s)	Sample Response(s)
1. Each item one wishes to cast presents its own set of pattern requirements. Patterns must be designed to replicate the product and be easily removed without damaging the mold. Explain the difference between a one piece and split pattern.	A one piece pattern can be used when the upper face of the pattern corresponds to the parting line and the separation point between the cope and drag as shown below.  A split pattern is made in two halves, split along the parting line to make it possible to remove the pattern without damaging the mold. See below.  Both the one piece and split pattern can be constructed out of the same materials and be aligned using a pattern board and/or drag pins. However, one piece patterns can sometimes be made from the actual object being replicated.
2. When are match plate patterns used?	Match plate patterns are used in conjunction with on-piece and split patterns to help speed up production. Gate and runner systems are often attached to match plate thus eliminating the need to cut them into the mold by hand.

For additional sample items and responses refer to:

- *Metalwork Technology and Practice*. Victor E. Repp, 1994. Text.
- *Modern Woodworking*. Willis H. Wagner et. al., 1996. Text.

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ACTIVITY ASSESSMENT: PATTERN WORK AND MOLD MAKING

Foundry 2: FAB2120–2

Module Learner Expectations

The student will:

- describe and perform safe start-up and shut-down procedures for the operation of a foundry furnace
- demonstrate basic pattern making skills to make a split pattern
- apply sand casting principles and skills to make a casting from a split pattern

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help

Content

☐ identifies the parts of a foundry furnace
☐ describes and demonstrates the safe operation of a foundry furnace
☐ identifies the hazards related to heating and pouring metal
☐ outlines an appropriate emergency response in the event of an accident

Use of Equipment and Materials

☐ follows accepted start-up and shut-down practices
☐ uses proper personal protective equipment
☐ observes proper lifting, handling and storage procedures

Use of Equipment and Materials (continued)

☐ calculates and measures accurately
☐ minimizes waste of materials
☐ fulfills expected clean-up responsibilities
☐ recognizes and controls potential health and safety hazards

Fabrication Techniques

☐ prepares/produces a split pattern
☐ creates a sand mold
☐ produces a finished sand casting according to the design specifications

Teamwork

☐ cooperates with group members in structured and non-structured settings
☐ shares equipment and work appropriately among group members
☐ negotiates solutions to problems

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Fabrication Techniques	4 3 2 1 0	2	
Teamwork	4 3 2 1 0	2	

FABRICATION PROCESS: STRAIGHT TURNING

Precision Turning 1: FAB2130–1

Module Learner Expectations

The student will:

- identify health and safety hazards specific to metal turning, and take preventive measures to avoid accidents and personal injury to self and others
- perform safe metal lathe set-up, operation and shut-down procedures
- demonstrate basic straight turning and finishing skills

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help
☐ reads a machine drawing to identify:
  - type of materials
  - overall and detailed dimensions
  - fits and tolerances
  - finishes

Use of Equipment and Materials
☐ selects and uses appropriate equipment/materials safely
☐ uses proper personal protective equipment
☐ follows proper lifting, handling and storage procedures
☐ calculates and measures accurately

Use of Equipment and Materials (continued)
☐ minimizes waste of materials
☐ fulfills expected clean-up responsibilities
☐ recognizes and controls potential health and safety hazards

Machining Skills
☐ demonstrates basic skills related to:
  - facing
  - centre drilling
  - rough and finish sizing
  - drilling
  - finishing
  - knurling
  - parting
  - assembling
☐ describes procedures to improve product quality and productivity

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Machining Skills	4 3 2 1 0	2	

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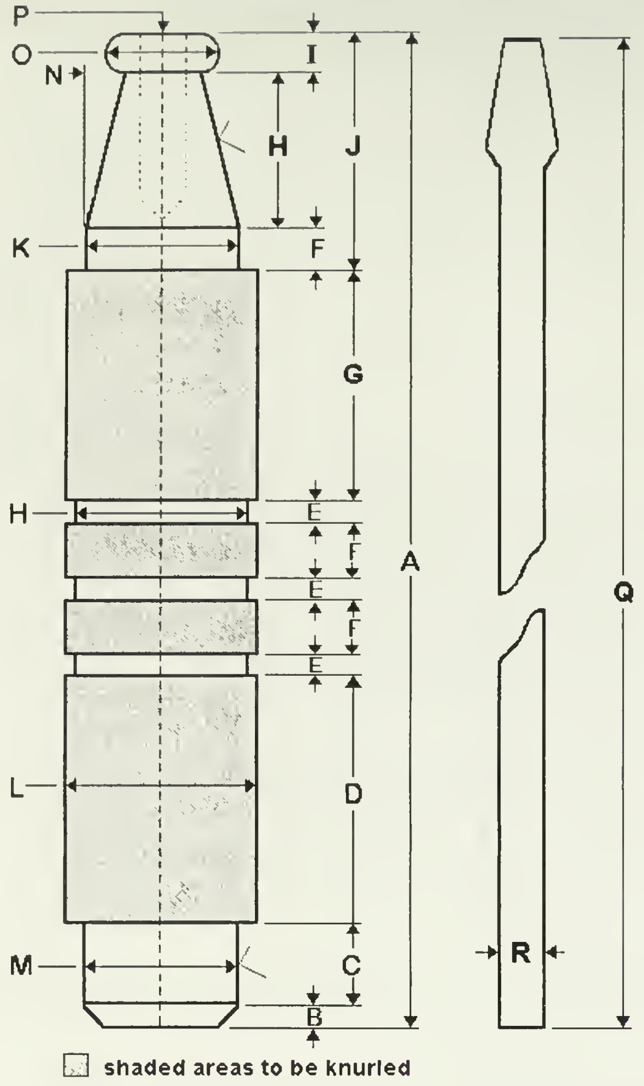
ILLUSTRATIVE EXAMPLE: SCREWDRIVER

Precision Turning 1: FAB2130–2



A.	128 mm
B.	2 mm
C.	10 mm
D.	32 mm
E.	3 mm
F.	6 mm
G.	30 mm
H.	22 mm
I.	5 mm
J.	33 mm
K.	20 mm
L.	25 mm
M.	19 mm
N.	10 mm
O.	15 mm
P.	'C' x 25
Q.	165 mm
R.	6.4 mm
S.	Demo

Quality Appraisal

Specific Assessment	Indicators	Actual
1. Dimensioning		
• Diameter "M" - 19 mm	± 1 mm	
• Diameter "L" - 25 mm	± 1 mm	
• Diameter "H" - 22 mm	± 1 mm	
• Diameter "K" - 20 mm	± 1 mm	
• Diameter "O" - 15 mm	± 1 mm	
• Length "A" - 128 mm	± 2 mm	
• Length "D" - 32 mm	± 1 mm	
• Length "G" - 30 mm	± 1 mm	
• Length "J" - 33 mm	± 1 mm	
• Length of Q-P -145 mm	± 3 mm	
2. Shape of finished tip	• as per drawing	
3. Finishing		
• Knurling	• even diamond pattern	
• Chamfer	• 60° with edges rounded off	
• Finish	• smooth machined surface	
4. Fit, blade to handle	• press fit	

This screwdriver is a good intermediate project that incorporates principles of machining and forging. The handle can be made from recycled aluminium or 1" round bar stock. The project will take between 4 to 6 hours for the beginning student.

Project prepared by Mike Blackwell, Wetaskiwin Composite High School, Wetaskiwin

FABRICATION PROCEDURES

Step	Operation		Precaution	Step	Operation		Precaution
1	Use power hacksaw to cut off aluminium stock 25 mm diameter x 145 mm long	☐	Make sure work is secure in saw vise	13.	Using dividers and steel rule mark out length "G" and "F" (cutter width is 3mm), width "E" Use cross feed and cut to diameter "H"	☐	All measurements should be made to the **tailstock side** of the cutter
2	Place stock in 3 Jaw lathe chuck and **face off both ends**	☐	Make sure stock is extended **no more** than 25 mm out from chuck jaws	14.	**Reverse** work in lathe and let approximately 25 mm. protrude. Measure out distance "D" of stock to diameter "M"	☐	Take two cuts to reduce diameter and use vernier calliper to check for final size **before** making last cut
3	Centre drill **both ends** at least ½ way up taper of center drill	☐	Tailstock lock must be off	15.	Mark out distance "C" and "B" and face off excess material to finished length	☐	Hold handwheel while facing off work
4	Place one end of stock in 3 Jaw Chuck at least 15 mm in and ensure other end is supported by the tailstock	☐	Tailstock spindle clamp should be clamped to the lathe bed and spindle locked	16.	Use a **single cut** file, chamfer end to 60 deg. angle size "B"	☐	Keep arms clear of chuck
5	Knurl stock from headstock end, toward tailstock end of lathe	☐	Check with teacher **before** attempting this step	17.	Reverse work in lathe and let 40 mm protrude from chuck jaws. Round distance "I" with single cut file	☐	Keep arms clear of chuck
6	**Reverse** stock in the lathe with a minimum of 15 mm in the lathe chuck	☐	Reset the tailstock and engage both clamps	18.	Polish length "J" and "C" and "B" with emery cloth	☐	Hold cloth as per demonstration
7	Using dividers and a steel rule, mark out distance "J" and align cutting tool point with divider point	☐	Cutting tool SHOULD NOT be touching work before lathe is turned on	19.	Check work with 25 mm protruding from the chuck jaws and drill hole "P". (Use letter drill "C")	☐	Use tailstock scale to measure drill depth
8	Turn lathe on and move cross-feed in until tool touches the revolving workpiece and has cut a light ring all the way around	☐	Hold handwheel with one hand for this operation	20.	Cut off tip stock to length "Q"	☐	Use **hand** saw
9	Reduce length "J" to diameter "K" taking 2 cuts using automatic feed. Total reduction should be L-K . Stop lathe after 2 mm along length on 2nd cut and check for final size with digital vernier calliper	☐	Make sure cutting tool is just touching rotating work before zeroing out cross feed collar	21.	Forge tip to rough size as per demonstration	☐	Exercise care using the cutting torch or other heat source
10	Using dividers and a steel rule, mark out length "I" and reduce to diameter "O". Use vernier to check before final cut	☐	Same procedures as steps 7, 8, 9. Feed by hand for this cut	22.	Grind tip to shape as per demonstration	☐	Keep work supported while grinding
11	Cut taper "H" using taper attachment method, moving from headstock to tailstock end. Take 3 cuts to finish taper	☐	Set taper attachment at 10 deg. and hand feed	23.	Draw file and polish as per demonstration	☐	Use emery cloth as shown
12	Set up **parting tool** and turret holder	☐	Check with teacher **before** proceeding with this step	24.	Fit handle to tip	☐	Ask teacher to assist with this operation
				25.	Mount handle in lathe and repolish tip	☐	

Project Prepared by Mike Blackwell, Wetaskiwin Composite High School

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Module Learner Expectations

The student will:

- identify health and safety hazards specific to milling operations, and take preventive measures to avoid accidents and personal injury to self and others
- demonstrate basic milling machine skills and practices

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

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0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ adheres to established timelines
☐ thinks through problems before asking for help
☐ reads a machine drawing to identify:
  - type of materials
  - overall and detailed dimensions
  - finishes

Use of Equipment and Materials

☐ selects and uses appropriate equipment/materials safely
☐ uses proper personal protective equipment
☐ follows proper lifting, handling and storage procedures
☐ calculates and measures accurately
☐ minimizes waste of materials
☐ fulfills expected clean-up responsibilities
☐ recognizes and controls potential health and safety hazards

Machining Skills

☐ demonstrates basic skills related to:
  - rough sizing
  - squaring and bevelling
  - finishing

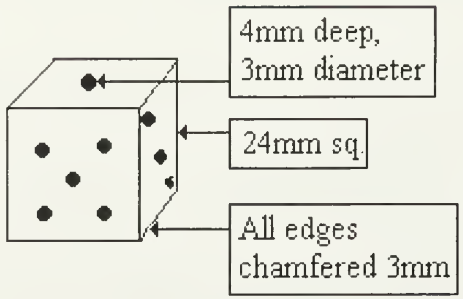
to the prescribed tolerances and specifications
☐ describes procedures to improve product quality and productivity

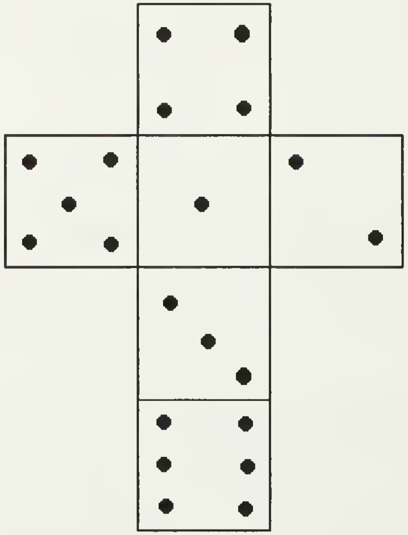
PERFORMANCE ASSESSMENT

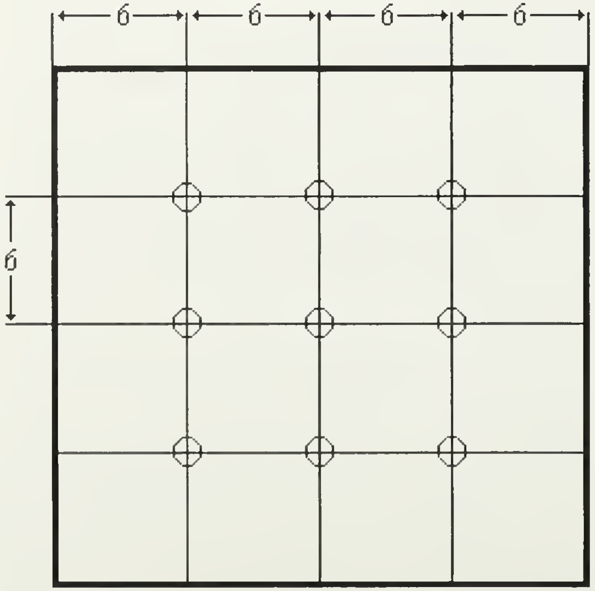
CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Use of Equipment and Materials	4 3 2 1 0	2	
Machining Skills	4 3 2 1 0	2	

ILLUSTRATIVE EXAMPLE: ALUMINUM DICE

Precision Milling 1: FAB2140–2







Dice are an excellent intermediate project fabricated on a milling machine. The project involves cutting materials with a metal bandsaw, milling to size, filing a chamfer and drilling. This project will take 4–6 hours to complete. As a further quality indicator, a second die can be produced and compared to the first.

	Basic Procedure
1.	Cut material to size by hand or with a metal band saw
2.	With teacher's permission and checked, set up on milling machine, proceed to mill aluminium square stock to specified dimensions.
3.	Proceed to file a 15 degree chamfer on all leading edges as shown on diagram.
4.	Use fine emery cloth to clean up all scratches and milling marks.
5.	Polish each die using #11 tripoli on a metal buffer.
6.	Layout and centre punch all holes to be drilled on die as specified.
7.	With teacher's permission, use drill press to drill all required holes to the specified depth.
8.	Check each die for nicks and scratches and repolish as necessary.
9.	As a further quality indicator, produce a second die and compare the first product.

Quality Indicators

	Specific Assessment	Standard
1.	Dimensioning	
	Overall height – 24 mm	± 2mm (1/16")
	Overall width – 24 mm	± 2mm (1/16")
	Overall length – 24 mm	± 2mm (1/16")
2.	Squaring	
	All sides are cut square	run out not more than 1 mm (1/32 inch) over each side
	File 15 degree chamfer on all edges	3 mm chamfer x 15 degree (1/8 inch)
3.	Finishing	
	Evidence of chipping	minimal
	Evident of file marks	
	Emery cloth marks	minimal
	Polishing – use #11 Tripoli on buffer	even
4.	Drilling	
	Drill bit size (4 mm – 1/8") All holes drilled to depth of 3 mm (1/8 inch)	holes of even depth, drilled and spaced according to blueprint

Project prepared by Clint Schwalbe, H.W. Pickup Junior High School, Drayton Valley

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PRODUCT ASSESSMENT: CUSTOM WORK

Custom Fabrication: FAB2160–1

Module Learner Expectations

The student will:

- demonstrate appropriate communicating and planning skills
- demonstrate effective resource management skills and practices
- demonstrate custom fabrication competencies

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals. Analyzes and provides effective client/customer services beyond expectations.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort. Analyzes and provides effective client/customer services.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals. Identifies and provides customer/client services.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively. Provides a limited range of customer/client services.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Planning and Management

- ☐ defines project outcomes
- ☐ communicates with the customer to determine:
    - customer needs
    - cost and time restraints
- ☐ conducts research pertaining to the task
- ☐ generates and considers the suitability of a number of design solutions
- ☐ works with the client to select a design that meets their needs
- ☐ creates an appropriate event sequence and time line

Client Service

- ☐ communicates frequently with client
- ☐ listens and responds to client requests
- ☐ apprises the client of any need to make changes
- ☐ fulfills condition of the contract
- ☐ follows up after work has been completed

Work Skills

- ☐ follows directions with limited prompting
- ☐ organizes work in an orderly manner
- ☐ works cooperatively with others in both structured and non-structured settings
- ☐ uses correct personal protective equipment
- ☐ follows proper lifting and handling procedures
- ☐ fulfills expected clean-up responsibilities
- ☐ stores, and disposes materials according to recommended procedures

Product Presentation

- ☐ describes the purpose of the project
- ☐ summarizes and reports on major events
- ☐ assesses design processes and production techniques
- ☐ suggests possible improvements to the design and production processes to better meet the client needs

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Planning and Management	4 3 2 1 0	2	
Client Services	4 3 2 1 0	2	
Work Skills	4 3 2 1 0	2	
Product Presentation	4 3 2 1 0	2	

RESEARCH PROCESS: PIPING SYSTEMS — Pipe Fitting: FAB2170–1

Module Learner Expectations

The student will:

- identify and describe common piping materials and applications.
- research and profile a trade or occupation within the pipe fitting field

Standard

Performance rating of 2 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards. Leads others to contribute team goals.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent. Works cooperatively and contributes ideas and suggestions that enhance team effort.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively to achieve team goals.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent. Works cooperatively.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ sets goals and establishes steps to achieve them
☐ creates and adheres to useful timelines
☐ creates personal initiative to formulate questions and find answers
☐ plans and uses time effectively

Information Gathering and Processing
☐ accesses a range of relevant school/community information resources
☐ uses a range of information-gathering techniques
☐ interprets, organizes and combines information into a logical sequence
☐ determines accuracy/currency/reliability of information sources

Content
☐ investigates and describes common types and applications of piping systems
☐ identifies common materials used to manufacturer pipe

Content (continued)
☐ lists and describes common fittings and components used in piping systems
☐ describes common methods of joining pipe
☐ identifies appropriate method of laying, hanging and/or securing pipe
☐ investigates career and further training opportunities related to pipe work by identifying:
- present and future career opportunities
- skill requirements
- training opportunities

Information Sharing
☐ demonstrates effective use of two or more communication media; e.g., written, oral, audio-visual
☐ communicates ideas in a logical sequence with sufficient supporting detail
☐ maintains acceptable grammatical and technical standards

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	2	
Information Gathering and Processing	4 3 2 1 0	2	
Content	4 3 2 1 0	2	
Information Sharing	4 3 2 1 0	2	

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Module Learner Expectations

The student will:

- describe the purpose and nature of materials testing
- apply testing principles to construct or use a piece of materials testing apparatus
- test and compare the properties of common materials used in construction and fabrication

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ plans and uses time effectively, safely and efficiently
☐ displays leadership in adhering to routine procedures
☐ attempts to solve problems prior to requesting help

Teamwork
☐ cooperates with group members
☐ shares work appropriately among group members
☐ negotiates with sensitivity for solutions to problems
☐ displays effective communication skills

Use of Equipment and Materials
☐ independently selects and uses equipment/materials
☐ demonstrates concern for safe procedures/ techniques
☐ weighs and measures accurately and efficiently
☐ minimizes waste of materials
☐ identifies and corrects potential health and safety hazards

Investigative Techniques
☐ makes predictions that can be tested, e.g., which material is the hardest
☐ plans, sets up and conducts experiments to test a prediction
☐ analyzes relationships among manipulated/ responding variables
☐ obtains accurate results that confirm/reject prediction and answers related questions
☐ summarizes, applies and evaluates experimental outcomes.

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Teamwork	4 3 2 1 0	3	
Use of Equipment and Materials	4 3 2 1 0	3	
Investigative Techniques	4 3 2 1 0	3	

FABRICATION PROCESS: TUNGSTEN ARC WELDING — Gas Tungsten Arc Welding: FAB3030–1

Module Learner Expectations

The student will:

- identify health and safety hazards associated with GTAW, and take preventive measures to avoid accidents and personal injury to self and others
- outline the advantages of GTAW over other forms of welding
- demonstrate basic GTAW competencies in the flat and horizontal positions

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning
☐ prepares for task and develops an effective work plan
☐ interprets and carries out instructions accurately
☐ plans and uses time in a logical manner
☐ attempts to solve problems prior to requesting help
☐ reads weld specifications to determine:
  - type of weld and position
  - type of weldment and filler metal
  - equipment settings
  - welding techniques

☐ identifies appropriate personal protection equipment (PPE) and ventilation controls

☐ **Content**
☐ lists the advantages and disadvantages of Gas Tungsten Arc Welding
☐ identifies common materials that can be welded with the GTAW process
☐ identifies and describes methods to cool a GTAW torch

Use of Equipment and Materials
☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes and corrects potential health and safety hazards
☐ fulfills clean-up and maintenance responsibilities

Task Performance
☐ completes mild steel fillet and groove welds in the:
  - flat
  - horizontal
  - vertical

positions as instructed

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Content	4 3 2 1 0	3	
Use of Equipment and Materials	4 3 2 1 0	3	
Task Performance	4 3 2 1 0	3	

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FABRICATION PROCESS: VERTICAL LAP AND TEE JOINTS — Arc Welding 3: FAB3050–1

Module Learner Expectations

The student will:

- examine and maintain sheet metal arc welding (SMAW) equipment and accessories
- read and interpret weld drawings and symbols
- demonstrate advanced level SMAW competencies in the vertical position

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

- ☐ prepares self for task and develops an effective work plan
- ☐ interprets and carries out instructions accurately
- ☐ plans and uses time in a logical manner
- ☐ attempts to solve problems prior to requesting help
- ☐ reads weld specifications and drawings to determine:
  - type of weld and position
  - type of weldment and filler metal
  - equipment settings
  - welding techniques
- ☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Content

- ☐ identifies components of a weld symbol
- ☐ describes how weld symbols are used to identify:
  - weld location
  - type of weld
  - root opening
  - type of filler metal

Use of Equipment and Materials

- ☐ wears the proper PPE
- ☐ follows accepted start-up, operation and shut-down procedures
- ☐ recognizes and corrects potential health and safety hazards
- ☐ maintains equipment according to the manufacturers' recommendations
- ☐ fulfills clean-up responsibilities

Task Performance

- ☐ produces two or more acceptable single and multi-pass vertical:
  - lap joint using 3/8" (10 mm) mild steel plate and E6010 (E41010) and E7018 (E48018) electrodes
  - outside corner joint using 3/8" (10 mm) mild steel plate and E6010 (E41010) and E7018 (E48018) electrodes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Content	4 3 2 1 0	3	
Use of Equipment and Materials	4 3 2 1 0	3	
Task Performance	4 3 2 1 0	3	

Module Learner Expectation

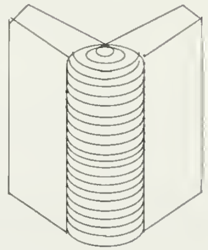
The student will:

- demonstrate advanced level SMAW competencies in the vertical position

PROCEDURE

Weld Type:	Outside Corner Weld
Position:	vertical
Base Metal:	2 – 3/8" x 2" x 5" (10 mm x 50 mm x 125 mm) mild steel plate
Preparation:	cut plates to 5" (125 mm) and wire brush corner joint
Filler Metal:	1/8" E6010 (E41010) electrodes
Number of Passes:	three
Machine Set-up:	DCRP, 90 –120 amps
Fit-up:	tack plates corner to corner at 90°
Manipulation:	electrode angle ½ of included joint angle with an electrode inclination of 10°–45°. Stringer bead root pass and weave fill and cover beads.

Task Performance Appraisal



Desirable Weld

The cover pass should be convex and smooth with close ripples that are free of voids, slag inclusion and high spots. Edges of the weld should have good fusion with no evidence of overlapping or undercutting. The back side should show complete and uniform penetration.

Acceptable Weld

Beads should be smooth and free of high spots, voids and slag inclusion. Penetration should be complete and evidence of spatter, overlapping and undercutting is minimal.

Comments:

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FABRICATION PROCESS: BUTT JOINT WELDS

Arc Welding 4: FAB3060–1

Module Learner Expectations

The student will:

- explain the effects heating and cooling have on a weld and weldment
- demonstrate advanced level sheet metal arc welding (SMAW) competencies in the flat, horizontal and vertical positions

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task
☐ organizes and works in an orderly manner
☐ interprets and carries out instructions accurately
☐ thinks through problems before asking for help
☐ reads weld specification and drawing to determine:
  - weld type and position
  - type of weldment
  - type of electrode
  - equipment settings
  - welding techniques
☐ lists variables that contribute to weld quality
☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Content

☐ describes the effects of heating and cooling on the base metal and previously deposited filler metal
☐ determines when it is necessary to preheat or postheat a weldment

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes and corrects potential health and safety hazards
☐ maintains equipment according to the manufacturers' recommendations
☐ fulfills clean-up responsibilities

Task Performance

☐ completes two or more acceptable multi-pass vee groove butt welds in the flat position, using 3/8" (10 mm) mild steel and E6010 (E41010) or E6011 (E41011) electrodes
☐ completes acceptable multi-pass vee groove butt welds in the flat, vertical and horizontal position using 3/8" (10 mm) mild steel and E6010 (E41010) or E6011 (E41011) electrodes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Content	4 3 2 1 0	3	
Use of Equipment and Materials	4 3 2 1 0	3	
Task Performance	4 3 2 1 0	3	

Module Learner Expectation

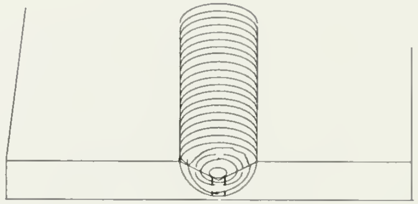
The student will:

- demonstrate advanced level sheet metal arc welding (SMAW) competencies in the flat, horizontal and vertical positions

PROCEDURE

Weld Type:	Vee-groove Butt Joint
Position:	flat
Base Metal:	2 – 3/8" x 2" x 5" (10 mm x 50 mm x 125 mm) mild steel plate
Preparation:	60° included angle 3/32"–1/8" (2 mm–3 mm) land, wire brush to remove oxides
Filler Metal:	E6010 or 11 (E41010 or 11) electrodes
Number of Passes:	three or four
Machine Set-up:	DCRP 90 –120 amps
Fit-up:	3/32"–1/8" (2 mm–3 mm) root opening, tacked on back side at each end
Manipulation:	electrode angle ½ of included joint angle (90°) electrode 0°–15° backhand on root fill and cap.

Task Performance Appraisal



Desirable Weld

Each pass should be of uniform width and height. Ripple should be close and free of voids, high spots and slag inclusion. Face of weld should be slightly convex and free of overlapping and undercutting. The back side of the weld should have complete and uniform penetration.

Acceptable Weld

Each pass should be smooth and free of high spots, voids and slag inclusion. Penetration should be complete and evidence of spatter, overlapping and undercutting is minimal.

Comments:

FABRICATION PROCESS: JOINT PREPARATION AND WELDING

Pipe & Tubular Welding: FAB3070–1

Module Learner Expectations

The student will:

- identify health and safety hazards associated with pipe and enclosed vessel welding, and take preventive measures to avoid accident and personal injury to self and others
- describe the advances made in pipe welding, and identify common types of joints and welding procedures
- demonstrate basic pipe/tube preparation and welding competencies

Standard

Performance rating of 3 or as stated for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence.

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively.

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately.

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately.

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares for task and develops an effective work plan
☐ interprets and carries out instructions accurately
☐ plans and uses time in a logical and efficient manner
☐ attempts to solve problems prior to requesting help
☐ reads weld specifications to determine:
  - type of weld and position
  - type of weldment and filler metal
  - equipment settings
  - welding techniques
☐ accurately lays out and prepares weld joints
☐ identifies appropriate personal protection equipment (PPE) and ventilation controls

Content

☐ describe the advantages of welding pipe over other fastening systems
☐ names the different type of pipe welds and welding processes
☐ describes typical methods used to align pipes/tubes prior to welding

Use of Equipment and Materials

☐ wears proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes and corrects potential health and safety hazards
☐ fulfills clean-up and maintenance responsibilities

Task Performance

☐ prepares joint appropriately
☐ selects appropriate welding process and filler metal
☐ completes an acceptable pipe/tube joint weld
☐ evaluates weld using destructive and none-destructive tests

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Content	4 3 2 1 0	3	
Use of Equipment and Materials	4 3 2 1 0	3	
Task Performance	4 3 2 1 0	3	

PRODUCT ASSESSMENT: PREFABRICATED PROJECT — Prefabrication Principles: FAB3160–1

Module Learner Expectations

The student will:

- perform basic shop drawing take-off skills
- exhibit advanced level resource management skills
- demonstrate appropriate prefabrication skills and practices

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Planning and Management
☐ determines the product outcome by analyzing performance needs and related issues
☐ generates a variety of different product ideas using available resources and advice from knowledgeable sources
☐ selects a solution that has a high potential for success
☐ analyzes drawings to determine an efficient and safe event sequence and production flow
☐ prepares a material estimate for the working drawings
☐ is sensitive to a variety of feedback mechanisms and alters plans when the current approach to the task is ineffective
☐ produces the necessary jigs and fixtures
☐ creates a meaningful timeline

☐ **Fabrication Techniques**
☐ rough cuts all lengths leaving room for mounting and finishing
☐ layout of all pieces according to plan
☐ prefabricates all pieces within stated tolerances
☐ finishes each part as required
☐ assembles parts according to product plan

Work Skills
☐ accurately interprets and follows directions
☐ creates and adheres to detailed timelines
☐ works cooperatively and collaboratively with others
☐ uses appropriate personal protective equipment
☐ models proper lifting, handling and storage procedures
☐ fulfills clean-up and tool maintenance responsibilities

Product Presentation
☐ describes the purpose and scope of the product
☐ summarizes and reports on major events
☐ assesses design processes and production techniques
☐ makes recommendations to improve product quality and productivity

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING	STANDARD	COMMENTS
Preparation and Planning	4 3 2 1 0	3	
Fabrication Techniques	4 3 2 1 0	3	
Work Skills	4 3 2 1 0	3	
Product Presentation	4 3 2 1 0	3	

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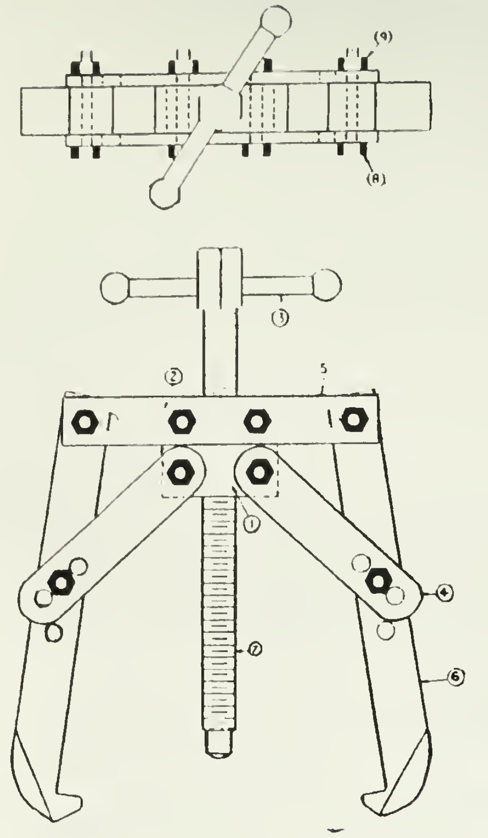
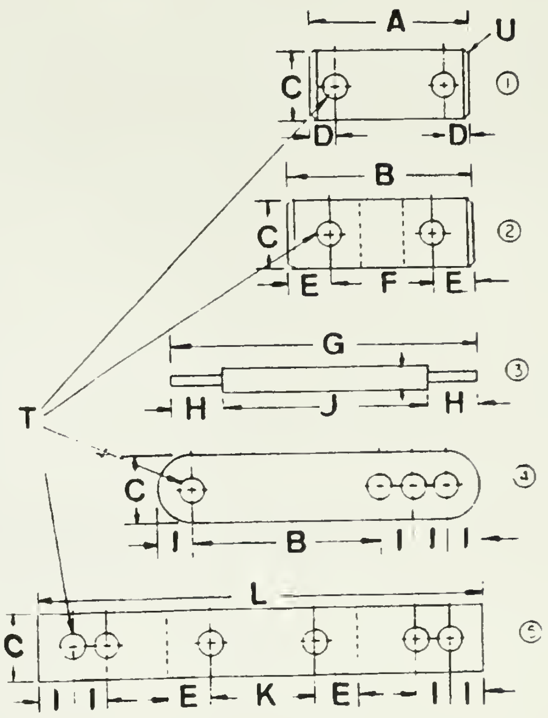


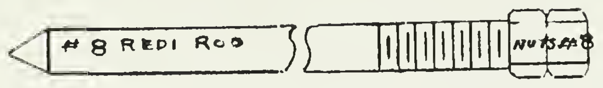
GEAR PULLER SPECIFICATIONS

MATERIALS			
Item	Description	Style	QT
	Bottom Spacer F.R. 1Z1 C.R. Steel	4000-D-0002-H01	1
2.	Top Spacer F.R. 1 x 1 C.R. Steel	4000-D-0002-H02	1
3.	Handle F.R. 3/8" Round, C.R. Steel	4000-D-0002-H03	1
4.	Side Arms F.R. 1 x 3/16 H.R. Flat Steel	4000-D-0002-H04	4
5.	Top Support F.R. 1 x 5/16"	4000-D-0002-H05	2
6.	Jaws F.R. 1 x 1 C.R. Steel	4000-D-0002-H06	2
7.	Threaded Shaft F.R. 1 Round C.R. Steel	4000-D-0002-H07	1
8.	Bolts 5/16 x 2 (N) N.C.	4000-D-0002-H08	8
9	Nuts 5/16 N.C.	4000-D-0002-H09	8

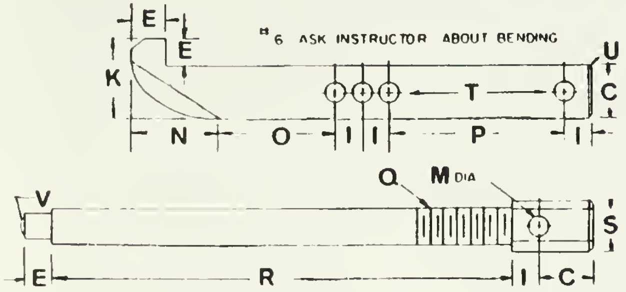
	*Metric	Imperial		*Metric	Imperial
A	60	2 ¼	L	160	6 3/8
B	67	2 ¾	M	10	3/8
C	25	1	N	40	1 9/16
D	10	3/8	O	55	2 1/8
E	15	5/8	P	80	3 ¼
F	37	1 ½	Q	M20X2	¾ - 11
G	115	4 ½	R	210	8 3/8
H	00	¾	S	22	7/8
I	12	½	T	8	5/16
J	75	3	U	45°	45°
K	37	1 1/2	V	10mm	3/8

Note: Project should be made in metric or Imperial - do not mix
*Soft conversion only





OPTION B



ILLUSTRATIVE EXAMPLE: GEAR PULLER (continued) — Prefabrication Principles: FAB3160–2

FABRICATION PROCEDURES		
Step	**Procedure**	**Options/Alternate Activities**
1.	Cut off all materials to **Rough Length**, as per blueprint.	use power saw **or** hand hacksaw
2.	Lay out all pieces to respective lengths and centre mark requirements.	use steel rule, square and scriber **or** surface gauge, vernier height gauges
3.	Centre punch and drill all holes as per blueprint.	use hand drill or drill press
4.	Straight and drawfile all required parts. (A, B & C)	use file for chamfers and surface grind parts (A, B and C)
5.	Bend jaw as per demonstration.	use oxyacetylene torch **or** forge
6.	Cut, shape and file to finished size.	use file **or** pedestal grinder
7.	Finish as per step #4.	use file on surface grinder and milling machine
8.	Fabricate threaded shaft.	use #8 ready rod **or** thread on the lathe use round or hexagon stock
9.	Finish thread end.	grind to point and harden and temper **or** drill on the lathe and install ball bearing as per demonstration
10.	Drill hole in hexagon head if optional handle is to be used.	machine handle and balls on lathe
11.	Assemble all parts using grade 5 bolts.	use bolts or machine pins with cotter pin holders

REFLECTIONS/COMMENTS:

QUALITY INDICATOR				
	Part Name	**Specific Assessment**	**Indicator**	**Actual**
1.	Bottom Spacer	– Finished length – Chamfers – Hole tapped square	∓.1 mm 45° & uniform 90°	
2.	Top Spacer	– Finished length – Chamfers – Hole drilled square	∓.1 mm 45° & uniform 90	
3.	Handle & Knobs	– Length of handle – Diameter of knobs	∓.1 mm ∓.1 mm	
4.	Side Supports	– Length – Radius – Holes	∓.1 mm 13 mm Radius gauge Straight & evenly spaced	
5.	Top Supports	– Length – Holes	∓.1 mm Straight & evenly spaced	
6.	Jaws	– Lengths – Chamfers – Holes – 45° Bevels – Lip Finish	∓.1 mm 45° uniform Straight & evenly spaced 45° uniform ∓.1 mm	
7.	Threaded Shaft	– Thread length – Thread fit – Thread finish – Ball bearing end & finish – Hex head – Hex finish & chamfer	∓.1 mm Class 3 Even & no chips ∓.1 mm Must fit 22 mm wrench 45° & uniform	
	Assembly	Fit and overall finish	Components are secure and operate smoothly	

Project prepared by Mike Blackwell, Wetaskiwin Composite High School

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FABRICATION PROCESS: FILLET AND BUTT WELDING ON MILD STEEL

Module Learner Expectations

The student will:

- describe the characteristics of a desirable gas metal and flux cored arc weld
- identify strategies to evaluate and improve weld quality
- demonstrate GMAW and FCAW competencies on mild steel plate in the flat, horizontal and vertical positions

Standard

Performance rating of 3 for each applicable task.

Rating Scale

The student:

4 exceeds defined outcomes. Plans and solves problems effectively and creatively in a self-directed manner. Tools, materials and/or processes are selected and used efficiently, effectively and with confidence. *Quality, particularly details and finishes, and productivity are consistent and exceed standards.*

3 meets defined outcomes. Plans and solves problems in a self-directed manner. Tools, materials and/or processes are selected and used efficiently and effectively. *Quality and productivity are consistent.*

2 meets defined outcomes. Plans and solves problems with limited assistance. Tools, materials and/or processes are selected and used appropriately. *Quality and productivity are reasonably consistent.*

1 meets defined outcomes. Follows a guided plan of action. A limited range of tools, materials and/or processes are used appropriately. *Quality and productivity are reasonably consistent.*

0 has not completed defined outcomes. Tools, materials and/or processes are used inappropriately.

TASK PERFORMANCE CRITERIA

The student:

Preparation and Planning

☐ prepares self for task and develops an effective work plan
☐ interprets and carries out instructions accurately
☐ plans and uses time in a logical manner
☐ attempts to solve problems prior to requesting help
☐ reads weld specifications and drawings to determine:
  - type of weld and position
  - type of weldment and filler metal
  - equipment settings
  - welding techniques

☐ identifies appropriate personal protective equipment (PPE) and ventilation controls

Content

☐ lists and describes the characteristics of a desirable weld and test methods
☐ discusses strategies to improve weld quality related to:
- mode of metal transfer
- type of filler metal
- machine set-up
- manipulation

Use of Equipment and Materials

☐ wears the proper PPE
☐ follows accepted start-up, operation and shut-down procedures
☐ recognizes and corrects potential health and safety hazards
☐ maintains equipment according to the manufacturers' recommendations
☐ fulfills clean-up responsibilities

Task Performance

☐ produces two or more acceptable multi-pass fillet and butt welds in the:
- flat
- horizontal
- vertical

positions using gas metal and/or flux core processes

PERFORMANCE ASSESSMENT

CRITERIA	STUDENT RATING					STANDARD	COMMENTS
Preparation and Planning	4	3	2	1	0	3	
Content	4	3	2	1	0	3	
Use of Equipment and Materials	4	3	2	1	0	3	
Task Performance	4	3	2	1	0	3	

ILLUSTRATIVE EXAMPLE: HORIZONTAL SINGLE VEE BUTT JOINT WELD

Module Learner Expectation

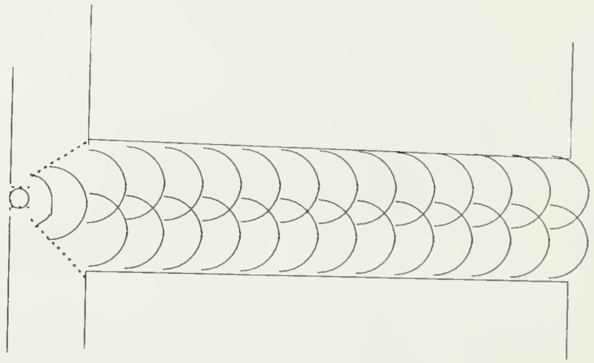
The student will:

- demonstrate GMAW and FCAW competencies on mild steel plate in the flat, horizontal and vertical positions

PROCEDURE

Weld Type:	Single Vee Butt Joint
Position:	horizontal
Base Metal:	2 – 3/8" x 2" x 5" (10 mm x 50 mm x 125 mm) mild steel plate
Preparation:	30° bevel, 1/16" (2 mm) land, wire brush to remove oxides
Filler Metal:	0.035" (0.9 mm) ER70S
Shielding Gas	CO_2
Number of Passes:	three to four stringer beads
Machine Set-up	according to the manufacturer's recommendations
Fit Up	5/32" (4 mm) root opening, tack on each end
Manipulation:	½ included angle with gravity correction. 15°–30° backhand root pass.

Task Performance Appraisal



Desirable Weld

There should be evidence of complete penetration. Beads should be straight and evenly spaced. Build up should be slightly higher than base metal. Excessive spatter on surface should not be evident.

Acceptable Weld

Each pass should be smooth and free of high spots and voids. Penetration should be complete and evidence of spatter should be minimal.

Comments:

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EQUIPMENT CHECKLIST: DRILL PRESS

FABEQUIP–1

STANDARD: all procedures to be performed correctly

Name: ____________________ Date: ____________________

*START-UP PROCEDURES

The student:

☐ operates the equipment only with the teacher's permission
☐ removes/confines loose apparel and long hair
☐ selects the proper personal protective equipment
☐ selects and mounts the proper drill bit or accessory
☐ removes the key from the chuck
☐ adjusts the machine to the correct speed
☐ checks the condition and position of all guards
☐ mounts the work securely in the proper vise or clamp
☐ adjusts the depth stop to the correct depth
☐ centre punches metal parts prior to drilling
☐ checks drill bit for straightness
☐ positions the work piece

*OPERATING PROCEDURES

The student:

☐ wears the proper PPE; e.g., goggles or face shield
☐ checks drill bit alignment and depth of cut
☐ applies even pressure when drilling
☐ raises the drill bit occasionally to clear cuttings
☐ eases up on drilling pressure as the drill breaks through the work
☐ uses cutting fluids if necessary
☐ drills a pilot hole for larger holes
☐ uses a V-block to hold round stock
☐ removes cuttings with a brush
☐ keeps floor free from scrap materials
☐ sets speed or adjusts work only after the machine has come to a complete stop
☐ maintains proper clearance between drill press table and clamping devices

*SHUT-DOWN PROCEDURES

The student:

☐ removes and carefully stores work pieces
☐ returns tools and accessories to their proper location
☐ cleans the equipment and work area as instructed
☐ returns equipment to original state

REFLECTIONS/COMMENTS:

* **Procedures may differ according to each manufacturer's recommendations**

EQUIPMENT CHECKLIST: GRINDER–BENCH OR PEDESTAL

FABEQUIP-2

STANDARD: all procedures to be performed correctly

Name: ____________________

Date: ________________

*START-UP PROCEDURES

The student:

☐ operates the equipment with the teacher’s permission
☐ removes/confines loose apparel and long hair
☐ checks to see that all guards and safety shields are in place and properly adjusted
☐ makes sure tool rest is at the correct angle and distance from the stone
☐ checks condition of stone prior to turning on
☐ asks for assistance if the stone needs “dressing”
☐ selects proper personal protective equipment

*OPERATING PROCEDURES

The student:

☐ wears the proper PPE; e.g., goggles or face shield
☐ stands to one side when starting the machine
☐ small work pieces are held with locking pliers
☐ applies firm, even pressure allowing the wheel to operate at maximum RPM
☐ moves work piece across stone to prevent grooving
☐ always grinds on face of wheel
☐ always grinds on the down side or below the centreline of the stone
☐ reports grinding wheels that are worn down or cracked

*SHUT-DOWN PROCEDURES

The student:

☐ allows the machine to come to a full stop before cleaning up or leaving the work site
☐ returns tools

REFLECTIONS/COMMENTS:

* **Procedures may differ according to each manufacturer’s recommendations**

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EQUIPMENT CHECKLIST: METAL LATHE

FABEQUIP–3

STANDARD: all procedures to be performed correctly

Name: ______________________

Date: ____________________

*START-UP PROCEDURES

The student:

☐ operates the equipment only with the teacher's permission
☐ removes/confines loose apparel and long hair
☐ selects the proper personal protective equipment - particularly eye protection
☐ properly mounts and secures work
☐ always removes the chuck key
☐ rotates spindle by hand to check for clearance
☐ mounts the appropriate cutter
☐ selects/adjusts for the proper depth of cut, spindle speed and feed rate

*OPERATING PROCEDURES

The student:

☐ wears the proper PPE; e.g., safety glasses or goggles
☐ rechecks all adjustments with the power turned off
☐ "jog" starts (on off) to check operation before fully engaging the power
☐ uses coolants and lubricants where applicable
☐ stops machines before clearing chips away with a brush
☐ maintains proper feed and spindle speed parameters
☐ removes tool holder and post before filing or polishing
☐ keeps hands away from all moving parts
☐ remains with the machine for the duration of each operation

*SHUT-DOWN PROCEDURES

The student:

☐ removes and carefully stores workpiece and lathe accessories
☐ returns all tools to their proper panel
☐ cleans the equipment and work area as instructed
☐ returns equipment to original state

REFLECTIONS/COMMENTS:

*** Procedures may differ according to each manufacturer's recommendations.**

EQUIPMENT CHECKLIST: MILLING MACHINES

FABEQUIP–4

STANDARD: all procedures to be performed correctly

Name: ______________________

Date: ______________________

*START-UP PROCEDURES

The student:

☐ operates the equipment only with the teacher's permission
☐ removes/confines loose apparel and long hair
☐ selects the proper personal protective equipment - particularly eye protection
☐ checks to see that all guards are in place
☐ selects the appropriate cutters for a specific milling application
☐ secures work by means of a vice or with clamps
☐ tightly mounts cutter in arbour or collet
☐ sets proper width and depth of cut; cutter speed and feed rate

*OPERATING PROCEDURES

The student:

☐ wears the proper PPE; e.g., safety glasses or goggles
☐ rechecks all adjustments with the power turned off
☐ "jog" starts (on off) to check operation before fully engaging the power
☐ makes sure cutters are rotating in the right direction
☐ uses coolants and lubricants where applicable
☐ stops machines before clearing chips away with a brush
☐ keeps hands away from cutters and points of operation
☐ remains with the machine for the duration of each operation

*SHUT-DOWN PROCEDURES

The student:

☐ removes and carefully stores cutters and workpieces
☐ returns all tools and accessories to their proper location
☐ cleans the equipment and work area
☐ returns equipment to original state

REFLECTIONS/COMMENTS:

* **Procedures may differ according to each manufacturer's recommendations.**

EQUIPMENT CHECKLIST: OAW START-UP AND SHUT-DOWN PROCEDURES

FABEQUIP–5

STANDARD: all steps to be performed correctly and in the proper sequence

Name: ____________________

Date: ____________________

*START-UP PROCEDURES (using cylinders)

The student:

☐ checks the condition of the workstation and cleared it of all physical hazards
☐ visually checks the torch valves, hoses, regulators, gauges, and personal protective equipment
☐ installs correct size of tip
☐ checks to see that the cylinder valves and torch needle valves are closed and regulator screws are backed off
☐ opens both the oxygen and acetylene cylinder valves as recommended by the manufacturer
☐ turns in regulator screws until pressure starts to rise on the gauges
☐ individually purges the oxygen and acetylene lines before lighting
☐ turns in regulator screws until the pressures rise to the appropriate welding pressures for both gases
☐ opens acetylene torch valve ¼ turn and lights with a striker
☐ ensures that the flame does not come in contact with equipment or combustibles
☐ adjusts the acetylene flame until it leaves the smoke range (stops producing heavy soot)
☐ opens the oxygen torch valve and adds oxygen to the flame until a neutral flame is established.

*SHUT-DOWN PROCEDURES (using cylinders)

The student:

☐ closes the acetylene torch needle valve before the oxygen valve
☐ closes the oxygen and acetylene cylinder valves
☐ opens and closes the acetylene and oxygen torch needle valve to bleed lines
☐ turns out acetylene and oxygen regulator adjusting screws
☐ rechecks cylinder valves, regulator and torch valves
☐ stores tip, torch and hoses as directed
☐ cleans-up the work station

REFLECTIONS/COMMENTS:

* **Procedures may differ according to each equipment manufacturer's recommendations.**

EQUIPMENT CHECKLIST: GMAW START-UP AND SHUT-DOWN PROCEDURES

FABEQUIP–6

STANDARD: all steps to be performed correctly and in the proper sequence

Name: ______________________ Date: ________________

*START-UP PROCEDURES

The student:

- ☐ checks the condition of the workstation, welding equipment and personal protective equipment
- ☐ puts up adequate screening for people in the immediate area
- ☐ ensures proper ventilation
- ☐ makes sure all electrical connections are correctly attached and grounded
- ☐ checks for the proper shielding gas and wire electrode
- ☐ adjusts the machine for the appropriate wire speed, voltage and amperage
- ☐ turns on shielding gas and checks flow meter
- ☐ checks shielding nozzle for gas obstructions
- ☐ uses the proper personal protective equipment
- ☐ posts a fire watch if necessary
- ☐ turns on machine

*SHUT-DOWN PROCEDURES

The student:

- ☐ carefully removes and cools all hot welding materials
- ☐ turns off power supply to welder
- ☐ shuts off shielding gas and closes the cylinder valve
- ☐ hangs up all cables and stores equipment as directed
- ☐ cleans up the work station

REFLECTIONS/COMMENTS:

* **Procedures may differ according to each equipment manufacturer's recommendations.**

FABRICATION

SECTION H: LINKAGES/TRANSITIONS

This section of the Guide has been designed to provide an overview of linkages and transitions of CTS modules with a number of organizations. The charts and information presented in this section will assist CTS students and teachers in understanding the potential application of CTS modules as students move into the workplace.

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LINKAGES/TRANSITIONS

There are many opportunities for students in Fabrication Studies to build linkages among CTS strands and across other subject areas, including core and complementary programs. In addition to making linkages across the curriculum, making connections between what students have already learned in other settings (e.g., home, community and workplace) can also be achieved through this strand.

LINKAGES

With Basic Competencies

The Fabrication Studies strand supports the development and integration of the basic competencies related to personal and resource management, problem solving, safe work practices and social interactions throughout the introductory, intermediate and advanced modules. It is important that students develop these competencies because success in the workplace often depends more on these skills than on many of the technical or academic skills they possess.

With Other CTS Strands

Fabrication Studies complements modules from a number of other strands, e.g., Agriculture, Communication Technology, Design Studies, Enterprise and Innovation, Construction Technologies, Forestry and Logistics.

Specific linkages that may be of interest to students in Fabrication Studies include:

Strand	Module	Linkage
Agriculture	Agrifoods 1 (AGR2050)	Construction of structures used in processing and storage of agriculture products, livestock and equipment.
Career Transitions	Project Modules	Provides opportunity and direction for students involved in projects beyond the expectations of a given Fabrication Studies module.
	Practicum Modules	Provides opportunity for students to work towards an externally developed and recognized credential related to the strand.
Construction Technologies	Climate Control Systems (CON2090)	Links with the sheet metal fabrication modules.
	Plumbing Systems (CON2080)	Links with Pipe Fitting.
Design Studies	Sketch, Draw & Model (DES1010)	Can be offered in conjunction with a student project and design module.
	Technical Drawing App. (DES2050)	Used in the context of house design and residential systems.
Energy and Mines	Refining Rocks & Minerals (ENM2070)	Provides a good background for metallurgy.
Enterprise and Innovation	Planning a Venture (ENT1020)	Used in conjunction with manufacturing and production modules.
Logistics	Purchasing 1 (LOG1040)	Used in conjunction with estimating and purchasing materials.

It is important to note that project, practicum and safety modules from the Career Transitions strand may be combined with modules from the Fabrication Studies strand to provide increased opportunity for students to develop expertise and refine their competencies in a particular area of study such as:

- acquiring safety skills and credentials
- completing a larger more complex product
- enhance specific welding sheet, metal and machining skills
- expanding a module topic or theme.

An example of a CTR Project module that has been developed as an extension to an existing module is shown in this section.

Linkages between the Fabrication Studies modules and other strands and across the curriculum have also been identified. Refer to "Fabrication Studies: Connections With Other CTS Strands" and "Fabrication Studies Connections Across the Curriculum."

In addition, modules may also be aligned according to the course emphasis and themes that run between modules and strands as outlined in "Fabrication Studies: Junior High School Module Clusters."

For a summary of modules that can be combined with the Fabrication Studies from other strands, refer to "Fabrication Studies: Extended Scope and Sequence."

With Elementary Programs

The development of concepts related to Fabrication Studies can begin as early as ECS using hand tool activities and teaching strategies similar to those outlined in the "Integrated Practical Activities for Elementary Grades" (Alberta Education, 1980).

With Other Secondary Programs

To help make learning more authentic and significant, it is important to integrate the core and complementary areas with Fabrication Studies. By being aware of and supporting the content of other curricula promotes the transfer of knowledge and skills and reinforces core and complementary courses as outlined in the following chart.

Subject	Linkage
Language Arts	Technical report writing, task analysis, event scheduling and oral and multimedia presentations.
Mathematics	Measurement, calculation of area and volume, use of fractions, ratios, geometry and trigonometry.
Science	Material properties, structures, chemical safety, use of simple machines and electricity as well as related environmental concerns.
Social Studies	Economics, impact of technology on society, resource development and industrial relationships.
CALM	Career assessment and preparation.
Art	Metal sculpture and casting
Drama	Stage prop construction and set design.

With Practical Arts Courses

As of September 1997, modules in the Fabrication Studies strand replaces many of the existing junior and senior high practical arts programs. A detailed correlation of the Fabrication Studies strand modules to the practical arts courses can be found in this section (see "Fabrication Studies: Correlations to Junior/Senior High School Practical Arts Courses").

TRANSITIONS

To the Community/Workplace

Competencies developed in Fabrication Studies provide students with many of the entry level skills required in the workplace (see "Fabrication Studies: Module Relationships to Specific Trades and Occupations").

The National Occupational Classification (NOC) shown in chart form in this section, indicates occupations for which Fabrication Studies provides a foundation (see "Fabrication Studies: Related Occupations"). According to this chart, high school students could potentially move into 12 occupations requiring high school education and nine trades related to Fabrication Studies.

To Related Post-secondary Programs

The themes and modules offered in Fabrication Studies are consistent with many of the pre-employment and apprenticeship courses now being offered by post-secondary institutions.

A number of articulation agreements have been established with post-secondary institutions in Alberta. These agreements provide preferred entrance and/or advanced standing/credit for CTS students who have successfully completed designated modules. A current summary of articulation agreements in place that involve CTS modules is available through Alberta Education's web site at <http://ednet.edc.gov.ab.ca>. For further information regarding particular articulation agreements, contact the post-secondary institution and/or review their respective calendar.

CTS courses in Fabrication Studies may also link with one or more of Alberta's Apprenticeship Training Programs; e.g., Welder, Machinist, Sheet Metal Worker. Students who are employed as an apprentice in one of these trade areas and have successfully completed designated CTS modules may also qualify, upon the recommendation of their employer, for a portion of the in-school training component. A summary of articulation agreements established for specific apprenticeship trades (including a correlation to CTS modules) is available through Alberta Education's web site. Further information regarding apprenticeship linkages can be obtained by contacting Alberta Advanced Education and Career Development, Apprenticeship and Industry Training Division.

An outline of post-secondary institutions in Alberta currently offering programs related to Fabrication Studies can be found in this section (see "Fabrication Studies: Summary of Related Post-secondary Programs").

CREDENTIALLING

Students may earn partial or complete credentials recognized in the workplace and/or post-secondary institutions by demonstrating specified competencies within the CTS curriculum. The Fabrication Studies strand, in conjunction with modules from the Career Transitions strand, provide opportunities for students to develop competencies related to:

- Explosive Actuated Tools
- Construction Safety Training
- Emergency First Aid
- CPR Level C
- Workplace Hazardous Materials Information System
- Transportation of Dangerous Goods.

Further information regarding credentialling in Fabrication Studies is provided in this section (see "Credentialling Opportunities in Fabrication Studies") and the *Career & Technology Studies Manual for Administrators, Counsellors and Teachers* , Appendix 14.

MODULE CTR3110: PROJECT 3A – OVERHEAD POSITION WELDING

Level: Advanced

Theme: Career Extensions

Prerequisite: None

Module Parameters: Students should have access to a fabrication work centre complete with shielded metal arc welding equipment and supplies and must have access to instruction from an individual with formal, specialized training in advanced arc welding practices.

Students extend and enhance competencies related to the development of overhead welding skills.

Curriculum and Assessment Standards

Module Learner Expectations	Assessment Criteria and Conditions	Suggested Emphasis
The student will:	*Assessment of student achievement should be based on:*	
• propose, manage and assess a project • meet goals as defined within the project plan	• successful completion of project including project: – proposal – management – completion – assessment – presentation *Assessment Tool* *CTR Project: Career Extensions Modules* • successful attainment of the standards for achievement outlined within the project plan *Assessment Tool* *CTR Project: Career Extensions Modules*	100
• demonstrate effort to develop basic competencies.	• observations of individual effort and interpersonal interaction during the learning process. *Assessment Tool* *Basic Competencies Reference Guide and any assessment tools noted above*	Integrated throughout

COURSE CTR3110: PROJECT 3A – OVERHEAD POSITION WELDING

Concept	Specific Outcomes	Notes
	The student should:	
Project Definition	• identify a project • prepare a project plan: – clarify the purposes of the project – define project deliverables – specify project timelines – explain terminology, tools and processes consistently throughout the project – define resource needs; e.g., materials, costs, staffing • identify and comply with all related health and safety standards • define assessment standards (indicators for success) • present project proposal and obtain necessary approvals.	Develop the skills necessary to weld lap joints on 3/8" (10 mm) mild steel in the overhead position using E41010, E48014 and E48018 filler material to trade standards.
Project Management	• proceed with the project as outlined with the project plan • monitor project and make necessary adjustments to project plan.	Project monitoring should include regular progress checks and consultation with teacher and others.
Project Presentation and Assessment	• present the project: – outcomes attained – relationship to goals set originally • evaluate the project: – processes and strategies used – recommendations for how the project could have been improved.	Project presentation could be in print, a display of the project or a description of the processes undertaken. Student assessment could be print, verbal and/or audio visual.

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LINKAGES – *Fabrication Studies: Connections with Other CTS Strands*

Fabrication Studies Courses	Agriculture	Career Transitions	Communication Technology	Community Health	Construction Technolgies	Cosmetology Studies	Design Studies	Energy and Mines	Electro-Technologies	Enterprise and Innovation	Fashion Studies	Financial Management	Foods	Forestry	Information Processing	Legal Studies	Logistics	Management and Marketing	Mechanics	Tourism Studies	Wildlife
	Other CTS Strands																				
Theme: Materials and Structures																					
FAB1010: Fabrication Tools & Materials		▨			■			▨													
FAB2010: Structural Engineering	■	▨			▨		▨														
FAB2020: Print Reading		▨			▨		▨														
FAB3010: Materials Testing		▨			▨														▨		
FAB3020: Metallurgy Fundamentals		▨						▨											▨		
Theme: Fabrication Processes																					
FAB1040: Oxyacetylene Welding	■	▨						▨											■		
FAB1050: Basic Electric Welding	■	▨						▨	▨										■		
FAB1110: Bar & Tubular Fabrication		▨																			
FAB1090: Sheet Fabrication 1 (Hand Processes)		▨																	▨		
FAB1100: Fabrication Principles		▨				▨													▨		
FAB2030: Oxyfuel Welding		▨																	■		
FAB2040: Thermal Cutting		▨																	▨		
FAB2050: Arc Welding 1	▨	▨							▨												
FAB2060: Arc Welding 2		▨							▨												
FAB2070: Gas Metal Arc Welding 1	▨	▨							▨										■		
FAB2170: Pipe Fitting		▨						▨													
FAB2090: Sheet Fabrication 2 (Machine Processes)		▨																			
FAB2100: Sheet Fabrication 3 (Parallel Line)		▨																			
FAB2110: Forging Fundamentals		▨																			
FAB3030: Gas Tungsten Arc Welding		▨							▨												
FAB3040: Specialized Welding		▨																	▨		
FAB3050: Arc Welding 3		▨							▨												
FAB3060: Arc Welding 4		▨							▨												
FAB3170: Gas Metal Arc Welding 2		▨							▨												
FAB3070: Pipe & Tubular Welding		▨						▨													
FAB3080: Automated Welding		▨							▨												
FAB3090: Sheet Fabrication 4 (Radial Line)		▨													▨						
FAB3110: Sheet Fabrication 5 (Duct Components)		▨																			
Theme: Production Systems and Processes																					
FAB1120: Foundry 1 (One-piece Pattern)		▨						▨													
FAB1130: Principles of Machining		▨						▨													
FAB1160: Production Systems		▨																			
FAB2120: Foundry 2 (Split Pattern)		▨																			
FAB2130: Precision Turning 1		▨																	▨		
FAB2140: Precision Milling 1		▨																	▨		
FAB2150: CNC Turning (Computer Numerical Control)		▨													▨						
FAB2160: Custom Fabrication		▨					▨														
FAB3120: Foundry 3 (Core Molding)		▨																			
FAB3130: Precision Turning 2		▨																			
FAB3140: Precision Milling 2		▨																			
FAB3150: CNC Milling (Computer Numerical Control)		▨													▨						
FAB3160: Prefabrication Principles		▨																			

Provides many direct links with competencies in this strand. Students will reinforce, extend and apply a substantial number of knowledge and/or skill components in practical situations.	■
Provides some links with competencies developed in this strand, usually through the application of related technologies and/or processes.	▨

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LINKAGES – *Fabrication Studies: Connections Across the Curriculum*

Across the Curriculum

Fabrication Studies Courses	Junior High							Senior High												
	Language Arts	Social Studies	Mathematics	Science	Health & PLS	Physical Education	Fine Arts	English	Social Studies	Mathematics	Science (General)	Biology	Chemistry	Physics	CALM	Physical Education	Fine Arts	Social Sciences	Second Language
Theme: Materials and Structures																			
FAB1010: Fabrication Tools & Materials				▨											▨				
FAB2010: Structural Engineering				▨											▨				
FAB2020: Print Reading															▨				
FAB3010: Materials Testing											▨			▨	▨				
FAB3020: Metallurgy Fundamentals														▨	▨				
Theme: Fabrication Processes																			
FAB1040: Oxyacetylene Welding											▨		▨		▨				
FAB1050: Basic Electric Welding											▨				▨				
FAB1110: Bar & Tubular Fabrication			▨												▨				
FAB1090: Sheet Fabrication 1 (Hand Processes)			▨							▨					▨				
FAB1100: Fabrication Principles											▨				▨				
FAB2030: Oxyfuel Welding											▨		▨		▨				
FAB2040: Thermal Cutting													▨		▨				
FAB2050: Arc Welding 1													▨		▨				
FAB2060: Arc Welding 2													▨		▨				
FAB2070: Gas Metal Arc Welding 1													▨		▨				
FAB2170: Pipe Fitting															▨				
FAB2090: Sheet Fabrication 2 (Machine Processes)										▨					▨				
FAB2100: Sheet Fabrication 3 (Parallel Line)										▨					▨				
FAB2110: Forging Fundamentals															▨				
FAB3030: Gas Tungsten Arc Welding													▨		▨				
FAB3040: Specialized Welding													▨		▨				
FAB3050: Arc Welding 3													▨		▨				
FAB3060: Arc Welding 4													▨		▨				
FAB3170: Gas Metal Arc Welding 2													▨		▨				
FAB3070: Pipe & Tubular Welding										▨			▨		▨				
FAB3080: Automated Welding															▨				
FAB3090: Sheet Fabrication 4 (Radial Line)										▨					▨				
FAB3110: Sheet Fabrication 5 (Duct Components)										▨					▨				
Theme: Production Systems and Processes																			
FAB1120: Foundry 1 (One-piece Pattern)				▨											▨				
FAB1130: Principles of Machining			▨												▨				
FAB1160: Production Systems															▨				
FAB2120: Foundry 2 (Split Pattern)															▨				
FAB2130: Precision Turning 1										▨					▨				
FAB2140: Precision Milling 1										▨					▨				
FAB2150: CNC Turning (Computer Numerical Control)										▨					▨				
FAB2160: Custom Fabrication															▨				
FAB3120: Foundry 3 (Core Molding)															▨				
FAB3130: Precision Turning 2										▨					▨				
FAB3140: Precision Milling 2										▨					▨				
FAB3150: CNC Milling (Computer Numerical Control)										▨					▨				
FAB3160: Prefabrication Principles															▨				

Provides many direct links with course content. Students will reinforce, extend and apply a substantial number of knowledge and/or skill components in practical contexts	■
Provides some links with course content, usually through the application of related technologies and/or processes.	▨

LINKAGES – *Fabrication Studies: Junior High School Course Clusters*

Course Emphasis	Fabrication Studies Courses	Construction Technologies Courses	Design Studies Courses	Energy & Mines Courses
Fabrication & Production Systems (3 courses)	Fabrication Tools & Materials (FAB1010)			
	Fabrication Principles (FAB1100)			
	Production Systems (FAB1160)			
Production & Processes (4 courses)	Fabrication Tools & Materials (FAB1010)			
	Foundry 1 (FAB1120)			
	Principles of Machining (FAB1130)			Fundamentals of Recycling (ENM1090)
Fabrication Processes (5 courses)	Fabrication Tools & Materials (FAB1010)		Sketch, Draw & Model (DES1010)	
	Fabrication Principles (FAB1100)			
	Basic Tools & Materials (CON1010)			
	Sheet Fabrication (FAB1090)			
Planning & Management (6 courses)	Fabrication Tools & Materials (FAB1010)	Project Management (CON1120)	Sketch, Draw & Model (DES1010)	
	Sheet Fabrication 1 (FAB1090)			
	Bar & Tubular Fabrication (FAB1110)			
	Principles of Machining (FAB1130)			

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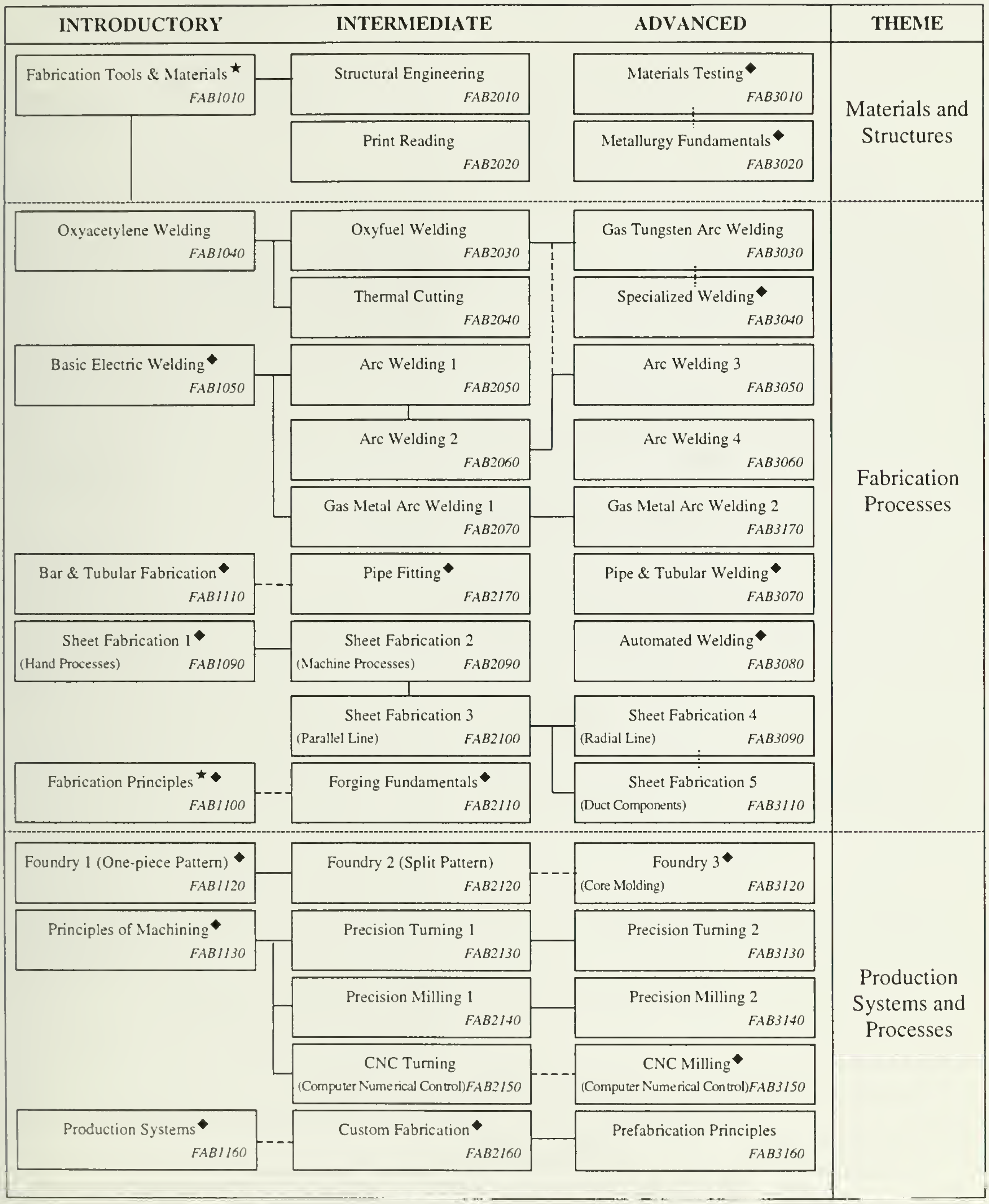
Fabrication Studies: *Scope and Sequence*



INTRODUCTORY	INTERMEDIATE	ADVANCED	THEME
Fabrication Tools & Materials★ *FAB1010*	Structural Engineering *FAB2010*	Materials Testing◆ *FAB3010*	Materials and Structures
	Print Reading *FAB2020*	Metallurgy Fundamentals◆ *FAB3020*	
Oxyacetylene Welding *FAB1040*	Oxyfuel Welding *FAB2030*	Gas Tungsten Arc Welding *FAB3030*	Fabrication Processes
	Thermal Cutting *FAB2040*	Specialized Welding◆ *FAB3040*	
Basic Electric Welding◆ *FAB1050*	Arc Welding 1 *FAB2050*	Arc Welding 3 *FAB3050*	
	Arc Welding 2 *FAB2060*	Arc Welding 4 *FAB3060*	
	Gas Metal Arc Welding 1 *FAB2070*	Gas Metal Arc Welding 2 *FAB3170*	
Bar & Tubular Fabrication◆ *FAB1110*	Pipe Fitting◆ *FAB2170*	Pipe & Tubular Welding◆ *FAB3070*	
Sheet Fabrication 1◆ (Hand Processes) *FAB1090*	Sheet Fabrication 2 (Machine Processes) *FAB2090*	Automated Welding◆ *FAB3080*	
	Sheet Fabrication 3 (Parallel Line) *FAB2100*	Sheet Fabrication 4 (Radial Line) *FAB3090*	
Fabrication Principles★◆ *FAB1100*	Forging Fundamentals◆ *FAB2110*	Sheet Fabrication 5 (Duct Components) *FAB3110*	
Foundry 1 (One-piece Pattern)◆ *FAB1120*	Foundry 2 (Split Pattern) *FAB2120*	Foundry 3◆ (Core Molding) *FAB3120*	Production Systems and Processes
Principles of Machining◆ *FAB1130*	Precision Turning 1 *FAB2130*	Precision Turning 2 *FAB3130*	
	Precision Milling 1 *FAB2140*	Precision Milling 2 *FAB3140*	
	CNC Turning (Computer Numerical Control)*FAB2150*	CNC Milling◆ (Computer Numerical Control)*FAB3150*	
Production Systems◆ *FAB1160*	Custom Fabrication◆ *FAB2160*	Prefabrication Principles *FAB3160*	

——— Prerequisite

- - - - - Recommended sequence

★ Course provides a strong foundation for further learning in this strand.

◆ Refer to specific courses for additional prerequisites.

LINKAGES – *Fabrication Studies: Extended Scope and Sequence*

THEME	INTRODUCTORY	INTERMEDIATE	ADVANCED
Materials and Structures	Refining Rocks & Minerals *ENM2070*	Technical Drawing App. *DES2050*	
Fabrication Processes	Electrical Fundamentals *MEC1090*		Practicum A (Explosive Actuated Tools) *CTR3040*
	Engine Fundamentals *MEC1040*	Framing Systems 1 *CON2040*	Generation /Transformation *ELT3040*
		Exterior Finishing *CON2060*	
		Robotics 2 *ELT2140*	
		Plumbing Systems *CON2080*	
		Climate Control Systems *CON2090*	
	Metal Forming & Finishing *MEC1170*	Agri-structures *CON2100*	
Production Systems and Processes	Project Management *CON1120*	Multiple Materials *CON2120*	Tool Maintenance *CON3120*
	Mold Making & Casting *CON1180*		
	CAD Fundamentals *DES1050*	CAD Applications *DES2030*	Info Management Tools *INF3080*
	Fundamentals of Recycling *ENM1090*		Managing the Venture *EAI3010*
		Manufacturing Systems *CON2190*	Production Planning *CON3190*
		Product Development *CON2200*	Production Management *CON3200*

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LINKAGES – *Fabrication Studies: Correlations with Junior/Senior High School Practical Arts Courses* *

Introductory, Intermediate and Advanced Courses	FAB1010: Fabrication Tools & Materials	FAB1040: Oxyacetylene Welding	FAB1050: Basic Electric Welding	FAB1110: Bar & Tubular Fabrication	FAB1090: Sheet Fabrication 1	FAB1100: Fabrication Principles	FAB1120: Foundry 1	FAB1130: Principles of Machining	FAB1160: Production Systems	FAB2010: Structural Engineering	FAB2020: Print Reading	FAB2030: Oxyfuel Welding	FAB2040: Thermal Cutting	FAB2050: Arc Welding 1	FAB2060: Arc Welding 2	FAB2070: Gas Metal Arc Welding 1	FAB2170: Pipe Fitting	FAB2090: Sheet Fabrication 2	FAB2100: Sheet Fabrication 3	FAB2110: Forging Fundamentals	FAB2120: Foundry 2	FAB2130: Precision Turning 1	FAB2140: Precision Milling 1	FAB2150: CNC Turning	FAB2160: Custom Fabrication	FAB3010: Materials Testing	FAB3020: Metallurgy Fundamentals	FAB3030: Gas Tungsten Arc Welding	FAB3040: Specialized Welding	FAB3050: Arc Welding 3	FAB3060: Arc Welding 4	FAB3170: Gas Metal Arc Welding 2	FAB3070: Pipe & Tubular Welding	FAB3080: Automated Welding	FAB3090: Sheet Fabrication 4	FAB3110: Sheet Fabrication 5	FAB3120: Foundry 3	FAB3130: Precision Turning 2	FAB3140: Precision Milling 2	FAB3150: CNC Milling	FAB3160: Prefabrication Principles	Design Studies
Junior High Practical Arts Courses																																										
Woods	X						X		X																																	
Metals	X	X	X	X	X	X		X	X																																	
Plastics	X				X	X	X	X	X																																	
Earths	X						X		X																																	
Leather/Textiles	X								X																																	
Industrial Stimulation	X								X																																	
Industrial Education 10, 20, 30 (1 credit)																																										
General Metal	X					X					X																															
Sheet Metal					X						X							X																								
Machine Metal								X														X	X																			
Arc Welding			X											X																												
Oxy-acetylene Welding		X										X																														
Foundry							X														X																X					
Vocational (5 credits)																																										
Welding 12		X	X									X	X												X																	
Welding 22A											X	X		X	X												X															
Welding 22B											X																			X	X		X									
Welding 22C											X					X										X		X	X			X									X	X
Welding 32A																																X	X	X								X
Welding 32B																									X		X		X												X	X
Welding 32C	Career Transitions Project Courses																																									
Sheet Metal 12	X				X	X					X																															
Sheet Metal 22A											X							X	X																X							
Sheet Metal 22B		X	X		X						X	X		X		X																										
Sheet Metal 22C											X								X																X	X						
Machine Shop 12	X					X		X			X											X	X				X															
Machine Shop 22A								X			X																X											X	X			
Machine Shop 22B																											X											X	X			
Piping 12				X		X					X						X																									
Related Mechanics 32A						X		X			X																X															
Related Mechanics 32B		X	X									X	X												X																	
Related Mechanics 32C	Career Transitions Project Coursees																																									

* September 1997: All practical arts courses replaced by Career and Technology Studies.

TRANSITIONS - *Fabrication Studies: Course Relationships to Specific Trades and Occupations*

Introductory, Intermediate and Advanced Courses	FAB1010: Fabrication Tools & Materials	FAB1040: Oxyacetylene Welding	FAB1050: Basic Electric Welding	FAB1110: Bar & Tubular Fabrication	FAB1090: Sheet Fabrication 1	FAB1110: Fabrication Principles	FAB1120: Foundry 1	FAB1130: Principles of Machining	FAB1160: Production Systems	FAB2010: Structural Engineering	FAB2020: Print Reading	FAB2030: Oxyfuel Welding	FAB2040: Thermal Cutting	FAB2050: Arc Welding 1	FAB2060: Arc Welding 2	FAB2070: Gas Metal Arc Welding 1	FAB2170: Pipe Fitting	FAB2090: Sheet Fabrication 2	FAB2100: Sheet Fabrication 3	FAB2110: Forging Fundamentals	FAB2120: Foundry 2	FAB2130: Precision Turning 1	FAB2140: Precision Milling 1	FAB2150: CNC Turning	FAB2160: Custom Fabrication	FAB3010: Materials Testing	FAB3020: Metallurgy Fundamentals	FAB3030: Gas Tungsten Arc Welding	FAB3040: Specialized Welding	FAB3050: Arc Welding 3	FAB3060: Arc Welding 4	FAB3170: Gas Metal Arc Welding 2	FAB3070: Pipe & Tubular Welding	FAB3080: Automated Welding	FAB3090: Sheet Fabrication 4	FAB3110: Sheet Fabrication 5	FAB3120: Foundry 3	FAB3130: Precision Turning 2	FAB3140: Precision Milling 2	FAB3150: CNC Milling	FAB3160: Prefabrication Principles
TRADES AND OCCUPATIONS																																									
Agricultural Mechanic	x	x	x			x		x				x	x	x	x	x	x					x	x				x		x			x						x	x		
Autobody Technician	x	x	x		x	x						x	x			x	x																								
Blacksmith and Die Setters	x			x		x	x		x		x	x	x							x					x																
Boilermaker	x					x					x	x	x	x	x										x																
Farrier	x					x														x					x																
Forging Machine Operators	x					x					x									x							x														
Ind. Eng. and Manufacturing Tech.	x					x		x	x		x											x	x	x	x									x						x	
Iron Worker	x	x	x	x		x				x	x									x																					x
Machinist	x					x	x	x	x		x										x	x	x	x	x	x	x										x	x	x	x	
Millwright	x	x	x	x	x	x		x			x	x	x	x	x	x	x			x	x	x	x				x			x	x	x					x				
Automotive Service Technician	x	x				x		x														x	x				x														
Materials Engineering Technologis	x	x	x	x	x	x	x	x	x	x	x									x	x					x	x														
Metalworking Machine Operators	x					x			x		x																x														
Sheet Metal Worker	x	x	x		x	x			x	x	x	x	x					x	x						x		x		x						x	x					x
Sprinkler Systems Installer	x			x		x					x														x																x
Steamfitter - Pipe Fitter	x	x	x	x		x					x	x		x											x		x						x								x
Structural Steel and Plate Fitter	x	x	x			x				x	x		x	x	x										x		x														
Tool and Die Maker	x					x	x	x	x		x									x	x	x	x	x	x	x	x										x	x	x	x	
Welder	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x							x
Plumbing	x			x		x					x	x													x		x														
Gas Fitting	x	x	x			x					x	x		x	x										x		x						x								
Refridgeration/Air Conditioning	x				x	x					x							x	x						x										x	x					

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TRANSITIONS – *Fabrication Studies: Related Occupations*

Information for this chart was obtained from the National Occupational Classification (NOC) descriptions.

Educational Requirements:

D:	High School Education	B:	College or Vocational Education
C:	Apprenticeship	A:	University

Occupational Profile	NOC#	D	C	B	A
Blacksmiths and Die Setters	7266	✓			
Boiler Maker	7262	✓			
Contractors and Supervisors, Metal Forming, Shaping and Erecting Occupations	7211	✓			
Forging Machine Operator	9512	✓			
Industrial Engineering and Manufacturing Technologists and Technicians	2233			✓	✓
Ironworker	7264		✓		
Labourer in Metal Fabrication	9612	✓			
Labourer in Rubber and Plastic Products Manufacturing	9615	✓			
Materials Engineering Technologist	2231/2233			✓	✓
Metalworking Machine Operator	9514	✓			
Other Metal Products Machine Operator	9516	✓			
Other Trades Helpers and Labourer	7612	✓			
Plastics Processing Machine Operator	9422	✓			
Plastic Products Assemblers, Finishers and Inspectors	9214	✓			
Rubber Processing Machine Operators and Related Workers	9423	✓			
Sheet Metal Worker	7261		✓		
Sprinkler Systems Installer	7252		✓		
Steamfitter–Pipefitter	7252		✓		
Structural Metal and Platework Fabricators and Fitters	7263		✓		
Supervisors, Plastic and Rubber Products Manufacturing	9214	✓			
Tool and Die Maker	7232		✓		
Welder	7265		✓		
Welding, Brazing and Soldering Machine Operators	9515	✓			

TRANSITIONS – *Fabrication Studies: Summary of Related Post-secondary Programs*

	PUBLIC COLLEGES											APPRENTICESHIP TRADE	PRIVATE COLLEGES					TECH. INST.		Banff	UNIVERSITIES			VOCATIONAL COLLEGES			
	Alberta College of Art & Design	Fairview College	Grande Prairie Regional College	Grant MacEwan Community College	Keyano College	Lakeland College	Lethbridge Community College	Medicine Hat College	Mount Royal College	Olds College	Red Deer College		Augustana University College	Canadian Union College	Concordia College	King's University College, The	North American Baptist College	Northern Alberta Institute of Technology	Southern Alberta Institute of Technology	Banff Centre	University of Alberta	University of Calgary	University of Lethbridge	AVC - Calgary	AVC - Edmonton	AVC - Lac La Biche	AVC - Lesser Slave Lake
Aeronautical/Mechanical Engineering Technology																			CD (3y)								
Agricultural Mechanic						C(16 w)				D		2y															
Aircraft Maintenance Engineering/Engineers Technology																		V	VD								
Arts (including Ceramics, Drawing, Glass, Jewellery, Metals)	D(4 y)		CD 2t	D	CD 2t			D2t	2t		D2t		B	V						V	BM	BM	BM				
Auto Body Technician												3y															
Automotive Service Technician (including Automotives/Automotive Service Technology, Gasoline Engine Performance Analysis, and Pre-employment		C			8w	C(12 w)	D	8w			D	4y						C	VD						VC	C(16 w)	
Boilermaker												3y															
Civil Engineering Technologies (including Building Construction, and Surveying and Mapping							D											D	D					C			C
Engineering (including degree programs in Agricultural, Chemical, Civil, Computer, Electrical, Engineering Physics, Mechanical, Metallurgical, Mining, Petroleum, and Survey			1t		1t			1t	1t 2t		1t			2t	1t						BMP hD	DBM PhD	1t				
Farrier Science		CD								C																	
Gas Fitter												3y															
Heavy Equipment/Industrial Operations (including Crane and Hoisting Equipment Operators, Crawler Tractor, Front End Loader, Hydraulic Backhoe Excavating, Motor Grader/Scraper)					C(5w)							1y2 y3y															

	PUBLIC COLLEGES												PRIVATE COLLEGES					TECH. INST.		Banff	UNIVERSITIES			VOCATIONAL COLLEGES			
	Alberta College of Art & Design	Fairview College	Grande Prairie Regional College	Grant MacEwan Community College	Keyano College	Lakeland College	Lethbridge Community College	Medicine Hat College	Mount Royal College	Olds College	Red Deer College	**APPRENTICESHIP TRADE**	Augustana University College	Canadian Union College	Concordia College	King's University College, The	North American Baptist College	Northern Alberta Institute of Technology	Southern Alberta Institute of Technology	Banff Centre	University of Alberta	University of Calgary	University of Lethbridge	AVC - Calgary	AVC - Edmonton	AVC - Lac La Biche	AVC - Lesser Slave Lake
Heavy Equipment Technician (including Diesel Mechanics, Industrial Heavy Equipment Technicians/Technology, Journeyman Updating and Pre-employment)		VC			8	C(16 w)	C				30w	4y						CD	C								
Iron Worker												3y															
Machinist												4y						C									
Mechanical Engineering Technologies (including Aeronautical, Aircraft Maintenance, Industrial Heavy Equipment, Materials, Operations Management and Welding)							D											D	D								
Millwright (including Pre-employment and Upgrading					8w							4y						VC									
Motorcycle Mechanic/Specialty Mechanics		C										4y															
Plumber (including Pre-employment)												4y															
Refrigeration/Air Conditioning												4y															
Sheet Metal Worker												4y															
Sprinkler Systems Installer												4y															
Steamfitter - Pipefitter (including Upgrading)												4y						V									
Structural Steel and Plate Fitter												3y															
Welder (including First Class to A & B Pressure, Pre-employment, upgrading to Journeyman)		V			8w	C(12 w)		8w			15w	3y						VC D	D					V		C(22 w)	

CODES:						
B	Bachelor's Degree	D	Diploma (2 years)	w	weeks
M	Master's Degree	V	Varies	m	months
Ph.D.	Doctoral Degree	1t	One-year transfer	y	years
C	Certificate (1 year or less)	2t	Two-year transfer		

*Information taken from "It's About Time: To Start Thinking About Your Future," Advanced Education and Career Development, 1995.

CREDENTIALLING – *Fabrication Studies: Credentialling Opportunities*★

The following credentialling opportunities link with modules in Fabrication Studies and other strands.

Certificate	Agency	Linking Modules	Instructor Qualifications	Comments
Explosive Actuated Tools	Technical Institute or College (post-secondary)	Concrete Work (CON3010)	EAT certificate	Required by OH&S for all operators to be certified. Formal credentialling to be arranged through local college or technical institutes.
Construction Safety training System	Alberta Construction Safety Association	Site Management (CON3110)	Alberta Construction Safety Association Trainer	Can be offered through a CD ROM Interactive Video Computer System.
Emergency First Aid	St John Ambulance Canadian Red Cross	Personal Safety Management (CTR1210)	Certified First Aid/CPR Instructor	3-year nationally recognized certificate.
CPR, Level C	St John Ambulance Canadian Red Cross	Practicum modules (CTR Practicum Modules A–E), CTR3040–3080	CPR Instructors	Nationally recognized certification "Basic Rescuer" includes airway management and CPR for adults, children, infants and 2-rescuer adult CPR (12 hours)
Workplace Hazardous Materials Information Systems (WHMIS)	Occupational Health and Safety	Personal Safety Management (CTR1210)	WHMIS Instructor	Addresses skills required to work safely with hazardous materials
Transportation of Dangerous Goods (TDG)	Alberta Transportation and Utilities	Workplace Safety Practices (CTR 2210)	TDG Instructor	Addresses skills required by individuals involved with the transportation and handling of dangerous goods

★ Further information regarding these and other credentialling opportunities available to CTS students is available through Alberta Education's web site at <http://ednet.edc.gov.ab.ca>.

SECTION I:
LEARNING RESOURCE GUIDE

This section of the GSI explains how to obtain up-to-date information regarding learning resources that have been identified to support the delivery of courses in this strand. It provides directions for searching, by electronic means, the most current information on:

- authorized student basic, support and authorized teaching resources—resources approved by Alberta Learning for use in this strand
- provincial software agreements—licensing agreements that allow school jurisdictions to purchase educational software at significantly reduced prices
- additional sources of information—other titles and information sources that may provide potentially useful ideas for courses in this strand.

The resource listings compiled for this strand are time sensitive and subject to change. Teachers are encouraged to browse the web sites identified in this guide on a regular basis for the most up-to-date information on new learning resources, more recent versions/editions and other sources of support.

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OTHER SOURCES OF SUPPORT I.5
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  National Film Board of Canada I.5
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NOTICE

SECTION I: LEARNING RESOURCE GUIDE

Alberta Learning authorizes a variety of resources that support learning and teaching in this strand. The 1999 and 2000 amendments to Section I provide directions for obtaining, by electronic means, up-to-date information about authorized resources and other sources of information.

Teachers are encouraged to browse the web sites identified in this guide on a regular basis for the most up-to-date information on:

- authorized resources; i.e., student basic, support, and authorized teaching
- provincial software licensing agreements
- additional sources of support.

The lists of authorized resources that were previously included in Section I have been removed from the 1999 and 2000 amendments to this document. Up-to-date listings of authorized resources can be accessed through:

- the Learning Resources Distributing Centre *Buyers Guide*, available electronically at <http://www.lrdc.edc.gov.ab.ca>
- the Authorized Resources Database, available electronically at <http://www.learning.gov.ab.ca> under Students and Learning, Learning and Teaching Resources.

Subsequent amendments to the *Guide to Standards and Implementation* for other CTS strands will include similar changes to Section I.

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LEARNING RESOURCE GUIDE

This section of the guide provides directions for obtaining, from electronic sources, up-to-date information about learning resources that support the delivery of CTS courses in this strand. Teachers may use the information to search for current listings of:

- authorized resources that support learning and teaching
  - basic learning resources
  - support learning resources
  - authorized teaching resources
- provincial software licensing agreements
- additional sources of information
  - other titles and sources that contain potentially useful information and ideas
  - web sites that may provide access to global networks of information.

Learning resources for this strand will continue to be updated in order to maintain and expand access to current information suitable for use in a variety of CTS learning environments.

CTS AND THE RESOURCE-BASED CLASSROOM

CTS supports the development of resource-based classrooms where a variety of appropriate, up-to-date print and nonprint resources are available. This approach enables students to:

- interact with a wide range of information sources
- access and use information sources appropriately
- take an active role in managing their own learning.

CTS identifies learning resources in print, software, video and CDROM formats, as well as other sources of information available in the community and through the Internet.

Collaboration between the teacher–librarian and CTS teacher in planning resource-based research activities will ensure that students develop research skills as they increase their understanding of subject content. Planned and purposeful research activities will help students learn to gather, process and share information, and will require access to a range of current print and nonprint resources available in the school library, other libraries, the community and/or from other sources.

Teachers are encouraged to reference *Focus on Research: A Guide to Developing Students' Research Skills,* referenced in the Alberta Learning Monographs section of this guide, when planning research activities.

LEARNING RESOURCE POLICY

Alberta Learning authorizes resources considered appropriate for provincial programs of study and that have met criteria for acceptability. The authorized resources for CTS include:

- student basic—resources that address the majority of the learner outcomes in one or more CTS courses
- student support—resources that assist in addressing some of the learner outcomes of a CTS course
- authorized teaching—resources that support the implementation of one or more CTS courses and assist teachers in the instructional process.

The Learning Technologies Branch also has developed distance education materials for a number of CTS courses. These course materials, also authorized by the province of Alberta, include a range of print and electronic products that can be used to support teaching and learning in CTS.

School boards may identify and approve instructional materials for use in their schools under section 44 (2) of the *School Act.* Many school boards have delegated the power to approve resources to school staff or other board employees under section 45 (1) of the *School Act.*

For further information on resource policy and definitions, refer to the *Student Learning Resources Policy* and *Teaching Resources Policy* or contact:

Learning Resources Unit
Learning and Teaching Resources Branch
Alberta Learning
5th Floor, Devonian Building, East Tower
11160 Jasper Avenue
Edmonton, AB, Canada T5K 0L2
Telephone: 780–422–4872 (to be connected toll free inside Alberta dial 310–0000)
Fax: 780–422–0576
Internet: <http://www.learning.gov.ab.ca>

HOW TO OBTAIN UP-TO-DATE INFORMATION

Authorized Resources

A searchable online index of all student basic, support and authorized teaching resources for courses in this CTS strand is provided through the Authorized Resources Database on the provincial web site. Each entry in the database provides bibliographic information about the resource, an annotation where appropriate, a correlation to specific 1-credit courses in this strand, and information about how to obtain the resource.

The Authorized Resources Database can be accessed at <http://www.learning.gov.ab.ca>:

- click on "Students and Learning"
- select "Learning and Teaching Resources"
- then select the "Authorized Resources Database."

When using the database to search for resources within a particular CTS strand:

- enter the strand name as the "Curricular Area"
- select the desired "Format" and "Authorization Status" from the options provided
- click on "Submit."

The database begins each list of student basic, support and authorized teaching resources with those resources that have been authorized most recently.

Upon first entering the database, the user is provided with a title and brief description of each resource, accompanied with copyright information, authorization status, number of pages and intended use by curriculum area and grades. Then by clicking on the "More" icon, a more detailed description of each resource can be obtained, along with additional information regarding publisher/distributor, physical appearance, cost, correlation to individual CTS courses, how to obtain the resource and where the resource can be previewed.

Up-to-date information regarding the availability of distance education materials for CTS courses (i.e., print products, electronic products, products in development) can also be obtained through the web site:

- click on "Students and Learning"
- select "Learning and Teaching Resources"
- then select the "Learning Technologies Branch."

Teachers are encouraged to browse the Authorized Resources Database and Learning Technologies Branch homepage on a regular basis for the most up-to-date information on authorized learning resources and distance education course materials that are available.

Provincial Software Agreements

Due to frequent upgrades occurring in productivity software (e.g., software packages developed for word processing, spreadsheet, database, multimedia, drawing and design applications), this kind of software is no longer authorized by the department. However, a number of provincial licensing agreements for software products are in place that allow school jurisdictions to purchase productivity software at significantly reduced prices.

An up-to-date listing of provincial software agreements can be obtained through the "Technology" section of the web site. Teachers are encouraged to browse this listing on a regular basis for information regarding additional provincial software licensing agreements that may be established from time to time.

HOW TO ORDER AUTHORIZED RESOURCES

Most of the student basic, support and authorized teaching resources can be obtained from the Learning Resources Distributing Centre (LRDC). The LRDC *Buyer's Guide*, available in electronic or print formats, provides a complete listing of resources available for purchase and additional ordering information. The LRDC can be contacted at:

12360 – 142 Street
Edmonton, AB, Canada T5L 4X9
Telephone: 780–427–5775 (to be connected toll free inside Alberta dial 310–0000)
Fax: 780–422–9750
Internet: <http://www.lrdc.edc.gov.ab.ca>.

It is recommended that all resources be previewed prior to purchase. In some instances, teachers may find it desirable to purchase one copy for their reference and additional copies as required.

ADDITIONAL SOURCES OF INFORMATION

There are many additional sources of information—other titles, and information available from government, professional associations, industry organizations and community agencies—that may provide potentially useful ideas for courses in this strand. Of further note are a number of web sites relevant to courses in this strand, which when used effectively, can provide both teachers and learners with a global network of useable information.

The responsibility to evaluate these additional sources of information prior to selection rests with the user, in accordance with any existing local policy.

CTS Council

An online listing of additional sources of information relevant to courses in this strand is available on the CTS Council web site at <http://ctscouncil.com>. The CTS Council welcomes your suggestions for maintaining and expanding the sources of information that are shared through this site.

Telus 2Learn Alliance

A searchable online listing of web sites containing information and materials relevant to courses in this strand is available through the Telus 2Learn Alliance at <http://www.2Learn.ca>. This site can be accessed through the CTS homepage by going to "Related Sites."

OTHER SOURCES OF SUPPORT

ACCESS: The Education Station

ACCESS: The Education Station offers a variety of resources and services to teachers. For a nominal dubbing and tape fee, ACCESS: The Education Station will copy audiotapes and videotapes for teachers.

ACCESS: The Education Station publishes listings of audiocassettes and videocassettes as well as a comprehensive programming schedule. For further information, visit their web site at <http://www.accesstv.ab.ca>.

National Film Board of Canada

The National Film Board of Canada (NFB) has numerous audiovisual resources that may be suitable for use in CTS courses. While these resources can be ordered directly from the NFB, many of their materials are also available in public libraries.

For a list of NFB audiovisual resources indexed by title and subject, or to place an order for audiovisual resources, visit their web site at <http://www.nfb.ca>.

Media and Resource Centres

There are a number of urban media and regional resource centres across the province that provide on a loan basis instructional materials that may support CTS courses. Teachers are encouraged to contact their local media or resource centre for further information regarding services that are available.

Urban Media Centres

Calgary Board of Education
Calgary, AB, Canada
Web site: <www.cbe.ab.ca>

Calgary Separate School Board
Calgary, AB, Canada
Web site: <www.crcssd1.calgary.ab.ca>

Edmonton Catholic School District
Edmonton, AB, Canada
Web site: <www.ecs.edmonton.ab.ca>

Edmonton Public School Board
Edmonton, AB, Canada
Web site: <www.epsb.edmonton.ab.ca>

Elk Island Public School Division
Sherwood Park, AB, Canada
Web site: <www.ei.educ.ab.ca>

Medicine Hat School District
Medicine Hat, AB, Canada
Web site: <www.sd76.ab.ca>

Northern Lights School Division
Spirit River, AB, Canada
Web site: <www.nlsd.ab.ca>
Red Deer Public School District
Red Deer, AB, Canada
Web site: <www.rdpsd.ab.ca>

Regional Resource Centres

Zone 1
Zone One Regional Resource Centre
Peace River, AB, Canada
Web site: (not yet available)

Zone 2/3
Central Alberta Media Services
Sherwood Park, AB, Canada
Web site: <www.cams.ab.ca>

Zone 4
Parkland Regional Library
Lacombe, AB, Canada
Web site: <www.prl.lacombe.ab.ca>

Zone 5
South Central Alberta Resource Centre
Strathmore, AB, Canada
Web site: (available in September 1999)

Zone 6
Southern Alberta Learning Resource Centre
Lethbridge, AB, Canada
Web site: (available in July 1999)

Alberta Learning Monographs

The following monographs are available for purchase from the Learning Resources Distributing Centre. Refer to the "Support Documents" section or the "Legal, Service and Information Publications" section in the LRDC *Buyers Guide* for ordering information and costs.

- *The Emerging Student: Relationships Among the Cognitive, Social and Physical Domains of Development,* 1991 (LRDC Product No. 161555)

  This document examines the child, or student, as a productive learner, integrating all the domains of development: cognitive, social and physical. It emphasizes the need for providing balanced curriculum and instruction.

- *Students' Interactions Developmental Framework: The Social Sphere,* 1988 (LRDC Product No. 161399)

  This document examines children's perceptual, structural and motor development and how such physical development affects certain learning processes.

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- *Focus on Research: A Guide to Developing Students' Research Skills,* 1990 (LRDC Product No. 161802)

  This document outlines a resource-based research model that helps students manage information effectively and efficiently, and gain skills that are transferable to school and work situations. This model provides a developmental approach to teaching students how to do research.

- *Teaching Thinking: Enhancing Learning,* 1990 (LRDC Product No. 161521)

  Principles and guidelines for cultivating thinking, ECS to Grade 12, have been developed in this resource. It offers a definition of thinking, describes nine basic principles on which the suggested practices are based, and discusses possible procedures for implementation in schools and classrooms.

[The 1997 text was deleted September 2000.]

Note

Effective September 2000, pages I.9 to I.30 have been deleted and not replaced.

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FABRICATION STUDIES

SECTION J: SAMPLE STUDENT LEARNING GUIDES

The following pages provide background information, strategies and a template for developing student learning guides. Also included at the end of this section are several sample student learning guides for Fabrication Studies.

A student learning guide provides information and direction to help students attain the expectations defined in a specified CTS course. It is designed to be used by students under the direction of a teacher.

Many excellent student learning guides (SLGs) are available for use and/or are in the process of being developed. While Alberta Learning provides a development template accompanied by some samples, most student learning guide development is being done by individuals and organizations across the province (e.g., school jurisdictions, specialist councils, post-secondary organizations).

Note: A student learning guide is not a self-contained learning package like those developed by the Learning Technologies Branch (LTB) or Distance Learning Options South (DLOS).

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  Components of a Student Learning Guide J.3
  Strategies for Developing Student Learning Guides J.4

SAMPLE STUDENT LEARNING GUIDE TEMPLATE J.5

SAMPLE STUDENT LEARNING GUIDES

  FAB1010 Fabrication Tools & Materials J.11
  FAB2010 Structural Engineering J.17
  FAB3010 Materials Testing J.27
  FAB3160 Prefabrication Principles J.33

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BACKGROUND INFORMATION

A Student Learning Guide (SLG) is a presentation of information and direction that will help students attain the expectations defined in a specified CTS module. It is designed to be used by students under the direction of a teacher. A SLG is not a self-contained learning package such as you might receive from the Alberta Distance Learning Centre (ADLC) or Distance Learning Options South (DLOS).

Each SLG is based on curriculum and assessment standards as defined for a particular CTS module. Curriculum and assessment standards are defined in this document through:

- module and specific learner expectations (Sections D, E and F)
- assessment criteria and conditions (Sections D, E and F)
- assessment tools (Section G).

The SLG is written with the student in mind and makes sense to the student in the context of his or her CTS program. SLGs are designed to guide students through modules under the direction of the teacher. They can be used to guide:

- an entire class
- a small groups of students
- individual students.

In some instances, the Student Learning Guide may also be used as teacher lesson plans. When using SLGs as teacher lesson plans, it should be noted that they tend to be:

- learner-centred (versus teacher-directed)
- activity-based (versus lecture-based)
- resource-based (versus textbook-based).

Components of a Student Learning Guide

The student learning guide format, as developed by Alberta Education, typically has *seven* components as described below.

1. *Why Take This Module?*

   This section provides a brief rationale for the work the student will do, and also establishes a context for learning (i.e., in relation to the strand, a life pursuit, a specific industry, etc.).

2. *What Do You Need To Know Before You Start?*

   In this section, prerequisite knowledge, skills and attitudes considered necessary for success in the module are identified. Prerequisites may include other modules from within the strand or from related CTS strands, as well as generic knowledge and skills (e.g., safety competencies, the ability to measure/write/draw, prior knowledge of basic information relevant to the area of study).

3. *What Will You Know And Be Able To Do When You Finish?*

   This information must parallel and reflect the curriculum and assessment standards as defined for the module. You may find it desirable to rewrite these standards in less formal language for student use.

4. *When Should Your Work Be Done?*

   This section provides a timeline that will guide the student in planning their work. The timeline will need to reflect your program and be specific to the assignments you give your students. You may wish to include a time management chart, a list of all assignments to be completed, and instructions to the student regarding the use of a daily planner (i.e., agenda book) to organize their work.

5. *How Will Your Mark For This Module Be Determined?*

   This section will interpret the assessment criteria and conditions, assessment standards, assessment tools and suggested emphasis as defined for the module within the context of the projects/tasks completed. Accepted grading practices will then be used to determine a percentage grade for the module—a mark not less than 50% for successful completion. (**Note**: A module is "successfully completed" when the student can demonstrate ALL of the exit-level competencies or MLEs defined for the module.)

6. *Which Resources May You Use?*

   Resources considered appropriate for completing the module and learning activities are identified in this section of the guide. The resources may be available through the Learning Resources Distributing Centre (LRDC) and/or through other agencies. Some SLGs may reference a single resource, while others may reference a range of resources. Resources may include those identified in the Learning Resource Guide (Section I) as well as other sources of information considered appropriate.

7. *Activities/Worksheets*

   This section provides student-centred and activity-based projects and assignments that support the module learner expectations. When appropriately aligned with curriculum and assessment standards, successful completion of the projects and assignments will also indicate successful completion of the module.

Strategies for Developing Student Learning Guides

Prior to commencing the development of a student learning guide, teachers are advised to obtain:

- the relevant Guide to Standards and Implementation
- the student learning guide template.

Information communicated to the student in the SLG must parallel and reflect the curriculum and assessment standards as defined for the module. Therefore, critical elements of the Guide to Standards and Implementation that need to be addressed throughout the SLG include:

- module and specific learner expectations
- assessment criteria and conditions
- assessment standards
- assessment tools.

Additional ideas and activities will need to be incorporated into the student learning guide. These can be obtained by:

- reflecting on projects and assignments you have used in delivering programs in the past
- identifying human and physical resources available within the school and community
- networking and exchanging ideas (including SLGs) with other teachers
- reviewing the range of resources (e.g., print, media, software) identified in the Learning Resource Guide (Section I) for a particular module/strand.

Copyright law must also be adhered to when preparing a SLG. Further information and guidelines regarding copyright law can be obtained by referring to the:

- *Copyright Act*
- *Copyright* and the *Can Copy Agreement.*

A final task in developing a student learning guide involves validating the level of difficulty/challenge/rigour established, and making adjustments as considered appropriate.

A template for developing student learning guides, also available on the Internet, is provided in this section (see "Student Learning Guide Template," pages J.5–10). Several sample student learning guides are also provided in this section (see "Sample Student Learning Guides," starting on page J.11.

CAREER &
TECHNOLOGY
STUDIES

SAMPLE STUDENT LEARNING GUIDE TEMPLATE

WHY TAKE THIS MODULE?

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

•
•
•
•
•
•
•
•

WHEN SHOULD YOUR WORK BE DONE?

HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	PERCENTAGE

WHICH RESOURCES MAY YOU USE?

•
•
•
•
•
•

ACTIVITIES/WORKSHEETS

CAREER & TECHNOLOGY STUDIES

FABRICATION STUDIES

SAMPLE STUDENT LEARNING GUIDE

FAB1010 Fabrication Tools & Materials

WHY TAKE THIS COURSE?

Ever since the beginning of the Stone Age, people have used technology to build needed artifacts and structures.
This course will:

- introduce you to common tools and materials
- help you understand the basic techniques used in fabrication processes
- experience the satisfaction of fabricating a useful product.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

There are no prerequisites identified for this course.

However, you should be able to read, follow directions and work with others in a safe manner.

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WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

Upon completion of this course you will be able to:

- identify and describe the safe use of basic hand tools
- identify and compare the properties of common metals used in fabrication activities
- apply fabrication processes and skills to produce a useful product
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this course.

You may also wish to use a time-management planning chart to preplan the work that needs to be done in this course. Plan how you will use your class time as well as extra time needed to complete the assignments in this course.

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HOW WILL YOUR MARK FOR THIS COURSE BE DETERMINED?

	PERCENTAGE
You must first demonstrate **all** of the competencies required for this course.	
When you have done this, your mark for the course will be determined as follows:	
• Tool Identification and Use Test (Hand Tools, FAB1010–1)	15%
• Report on the Properties of Building Materials (Material Identification, FAB1010–3)	10%
• Project Work (Product Assessment, FABPRD)	75%

WHICH RESOURCES MAY YOU USE?

- *Production Technology*, Stanley A. Komacek, 1993.
- *Technology Shaping Our World,* John Gradwell, et al., 1993.
- *Design and Technology*, Nelson, Colin Caborn, et al., 1989.

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ACTIVITIES/WORKSHEETS

1. Technological System

   1.1 People create technological systems to help solve problems. A system often includes these parts: input, process output and feedback. Select a simple household item and identify what:
   - input information and resources were required to make the product
   - processes were used to manufacture the product
   - were the intended and unintended outcomes
   - feedback the manufacturer might need to know to improve the product and the production process.

   1.2 Explain the difference between an open and a closed technological system.

2. Properties of Metals

   2.1 Designers and fabricators make choices about what metals they are going to use based on availability, cost and properties. Identify the cost and availability of five ferrous and/or non-ferrous metals commonly used in fabricating artifacts and structures.

   2.2 Properties of materials tell how a material can be expected to perform during and after fabrication. Identify a simple test that can be used to determine:
   - a mechanical property
   - a metal's reaction to heat
   - how chemicals affect the metal
   - its electrical and magnetic properties.

3. Tool and Equipment Identification

   As you work with technology, you will need to select the correct hand and power tools, and use these tools in a safe manner.

   3.1 Identify and describe the use of two or more tools that can be used safely to:
   - measure
   - mark a surface
   - cut through a metal
   - smooth a metal
   - form a metal
   - hold a metal
   - install a fastener
   - apply a finish.

4. Fabrication Process

4.1 Complete the following activities in consultation with your teacher:

- Choose a simple artifact or structure that can be made from common ferrous or non-ferrous metal.
- Locate a set of plans and a set of procedures that will help you fabricate the product.
- Identify and locate the appropriate materials and tools that are required to make the project.

4.2 The purpose of this activity is to design and fabricate a matching set of structures. One structure will be fabricated using Imperial measurements and the other using SI units of measurement. When you are finished fabricating these structures you will be asked the following questions:

- Which system of measurement was easier to use?
- Which system achieved the greatest accuracy?
- What design features did you incorporate into your plan to add strength to your structure?

Structures to consider fabricating are a set of:

- book ends
- shelf brackets
- “c” clamps.

Evaluation

Your marks for these activities will be based on:

- how well you plan and manage your project
- the work skills you develop and apply
- your project work
- presentation of your project.

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CAREER & TECHNOLOGY STUDIES

FABRICATION STUDIES

SAMPLE STUDENT LEARNING GUIDE

FAB2010 Structural Engineering

FAB2010 Structural Engineering

WHY TAKE THIS MODULE?

Structures are an essential part of our natural and constructed world. In this module you will:

- learn about many of the factors that designers and engineers need to consider when designing and building a structure
- be able to apply these principles to your project designs.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

Prerequisite: CON1010: Basic Tools & Materials

In addition, to be successful in this module you will need to apply basic math skills and be familiar with fabrication tools, materials and processes.

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

Upon completion of this module, you will be able to:

- list and describe the principal characteristics of all structures
- identify strategies to improve the efficiency of a structure
- apply principles of structural design to fabrication and construction activities
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this module.

You may also wish to use a time-management planning chart to preplan the work that needs to be done in this module. Plan how you will use your class time as well as extra time needed to complete the assignments in this module.

HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	PERCENTAGE
You must first demonstrate **all** of the competencies required for this module. When you have done this, your mark for the module will be determined as follows:	
• Behaviour of materials presentation	20%
• Structural analysis report	20%
• Project work (Building Structures, FAB2010–1)	60%

WHICH RESOURCES MAY YOU USE?

- *The Art of Construction*, Mario Salvadori, 1990.
- *Structure with Materials,* Steve Rich, 1991.
- *Design and Technology*, Colin Caborn, et al., 1989.

ACTIVITIES/WORKSHEETS

Investigation – Activity 1.0

1.1 Research Instructions: Using a separate sheet of paper, answer the following questions in statement form.

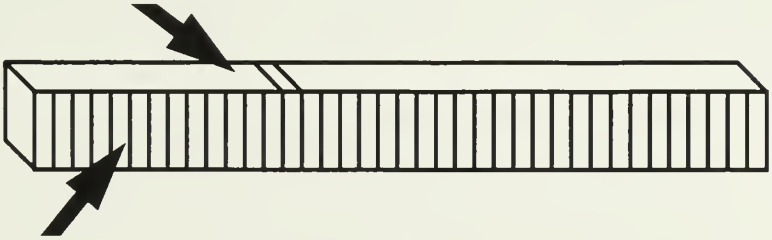
1. Define the term "structure."
2. List 5 natural or human-built structures within the current limits of your vision.
3. Classify these structures as being a frame, shell or non-rigid type structure or combination.
4. Select one of the objects and describe its structural elements.
5. Determine and list the function of each of the above elements.
6. Do any of the above elements provide more than one function? If so explain.
7. What materials are the 5 visible structures made of? Make a list of each.
8. What materials could be substituted for the materials that were used in the construction of these structures?
9. Make a list of these materials that are considered to be natural.
10. Make a list of these materials that are considered to be synthetic.
11. Look at the objects and determine which material(s) appear to be stronger, to wear or last longer.

Testing the Behaviour of Materials – Activity 2.0

Structural materials can all be tested for tensile strength, compressive strength, elasticity and ductility.

2.1 Tensile Testing

- Secure a piece of foam rubber approximately 30 cm (12") length and 5 cm (2") square.
- Using a ruler and felt marker, draw lines in 2.5 cm (1") intervals across the length of the rubber on 2 adjacent sides.



- Research the nature of a tensile load. Load the foam rubber with significant tensile stress and be sure to lock the foam into position securely for the remainder of this lab.
- On a separate sheet of paper sketch the effect of placing the foam rubber under tensile load.
- Measure the overall length of the foam rubber.
- Measure the width of the foam rubber across each of the lines and record the length at each.
- Examine the data and determine the relationship of the material and the loading.
- What general conclusion can you make from your experiment?
- List items currently in your vision which are under tensile load.

2.2 Compression Testing

Research the nature of a compressive load. Load the foam rubber with significant compressive stress and be sure to lock the foam into position securely for the remainder of this lab.

- On a separate sheet of paper sketch the effect of placing the foam rubber under the compressive load.
- Measure the overall length of the foam rubber
- Measure the width of the foam rubber across each of the lines and record the length of each.
- Examine the data and determine the relationship of the material and the loading.
- What general conclusion can you make from your experiment?
- List items currently in your vision which are under compressive load.

2.3 Testing for Elasticity

Research the nature of elasticity (deflection). To understand the nature of elasticity you should be able to set up and experiment using a ruler and strips of metal and plastic which are suspended between two points, e.g., the backs of two chairs.

- Place the metal strip on top of the chair back. Position the ruler to measure the amount of deflection of the metal strip at its centre point. Press down at the centre point of the metal strip to deflect 1 cm. Allow the metal strip to rebound (take the pressure off) and determine if the strip has returned to its original position.
- Continue to alternately measure and apply pressure, increasing 1 cm of deflection each time. Record the amount of deflection and rebound for each sequence forming a data chart.
- Determine the point at which you have exceeded the elastic capability of the material.
- Repeat the experiment using a strip of plastic.
- Which material has greater elasticity? Why?

2.4 Testing for Deflection

Research the nature of toughness (ductility). To understand the nature of toughness you should be able to set up and experiment using strips of metal and plastic which are repeatedly bent until failure results. This type of testing is called destructive testing because the structure is ultimately destroyed to determine its limits.

- Bend the strip of metal into a loop. While counting the cycles alternately move your hands apart, increasing the bend, and move them together, reducing the bend.
- As you are well aware the metal will fail sometime during the cycle. Note the number of cycles required to cause the material to fail.
- Repeat the experiment using a strip of plastic. Note the number of cycles required to cause the material to fail.
- Which material has greater toughness (ductility)? Why?

Structural Elements – Activity 3.0

3.1 Using a separate sheet of paper, answer the following questions in complete sentences.

1. Define the structural element called a beam.
2. Why is a beam described as a linear element?
3. What is the load carrying function of a beam?

4. What devices within your vision are used as beams?
5. Describe the structural force exerted on a beam?
6. Define the structural element called a column.
7. Why is a column describe as a vertical element?
8. What is the load carrying function of a column?
9. What devices within your vision are used as columns?
10. Describe the structural force exerted on a column
11. Define a non-rigid structural element.
12. How is a non-rigid structural element used?
13. What is the load carrying function of a non-rigid structural element?
14. What devices are used as non-rigid structural elements?
15. Describe the structural force exerted on a non-rigid structural element.
16. What would the function be of rigid and non-rigid materials connected to, or placed over, linear and vertical elements?
17. Give some examples of structures found in nature or in the world constructed using technology.
18. Define the structure commonly referred to as a truss.
19. Where are trusses used? (Give an example.)
20. Explain why trusses are rigid.
21. Describe the neutral axis of a beam.
22. How is a neutral axis calculated?
23. What is the effect of moving a load closer or further away from the neutral axis?

Structural Components – Activity 4.0

4.1 Structural components can all be tested for tensile strength, compressive strength, elasticity and toughness. You will now identify the action, reaction and result of these tests with the following lab.

- Secure a quantity of foam core, white glue and a razor knife from your teacher. On a cutting board cut 15, 2.5 cm (1") strips 30 cm (12") long.
- Glue the strips together to form 5, I beam structures.
- Place the I beam in a vertical position to form a column and secure it to a base.
- Place a suitable compressive load on the top of the beam forming a compressive load. Gradually increase the load to the point of failure.
- Determine the weight required (load) to cause failure.
- Determine the weight of the beam.
- Divide the value of the load by the weight of the beam to find the weight to strength ratio. (How many times its own weight will the beam support?)
- Prepare a base of wood for the next test. The edge of the base must be rounded to prevent the cutting of the bottom surface of the beam.
- Attach a beam horizontally to the base so that it extends 20 cm (8") beyond the base. Clamp the base to a table.
- Test the load carrying capability of the beam by suspending an unbreakable container of water or sand from the end of your beam.
- Slowly increase the amount of water until the weight causes the beam to fail.
- Examine the failed beam and determine the types of stress the test applied to the top and bottom surfaces of the beam.
- What are the physical characteristics of the structural failure?
- What is the strength to weight ratio for this test?

4.2 Structural shapes can be tested for shear, tension and twisting, Drawing on your previous experience devise and carry out a test for each. Write up your findings for each as you have for the previous lab. Be sure to:

- Examine the failed beam and determine the type of stress the test applied to the top and bottom surfaces of the beam.
- Determine the physical characteristics of the structural failure
- Calculate the strength to weight ratio for each test.

Building Structures – Activity 5.0

A model truss can be tested for loading. Drawing on your previous experience construct a truss model out of wood strips, metal or foam core. Devise and carry out a test for your truss.

5.1 Write up your findings for your experiment as you have for the previous lab. Be sure to:

- Examine the failed beam and determine the type of stress the test applied to the top and bottom surfaces of the beam.
- Determine the physical characteristics of the structural failure.
- Calculate the strength to weight ratio for each test.

5.2 It is a fantastic day at the ski hill. Clear sky, great powder snow, but just a bit windy. In the middle of a run a great wind comes up, you become lost and wind up in the wilderness in the middle of a blinding ground blizzard. As night falls you must construct an emergency shelter from your skis, poles, nylon cord, and a sizable piece of plastic, all of which you have been carrying around all day.

- Sketch your tent design. It must be free standing because you don't have stakes to drive into the snow.

- Determine and indicate the stress exerted from the wind and the collecting snow.

- Anticipate the most likely point of failure. Refer directly to your knowledge and experience of the previous tests.

5.3 A model tent can be tested for loading. Drawing on your previous experience, construct a tent model out of wood strips, metal or foam core and plastic sheeting. Devise and carry out a test for on your shelter.

- Write up your findings for your experiment as you have for the previous lab.
- Be sure to:
    1. Examine the failed structure and determine the type of stress the test applied to the elements.
    2. Determine the physical characteristics of the structural failure
    3. Calculate the strength to weight ratio for the test.

Project Application – Activity 6.0

6.1 Select an existing structure and prepare a presentation showing how you would redesign the structure to show increased efficiency by:

- reducing weight while maintaining strength
- enhancing its durability and usefulness
- reducing material and construction costs.

CAREER &
TECHNOLOGY
STUDIES

FABRICATION STUDIES

SAMPLE STUDENT LEARNING GUIDE

FAB3010 Materials Testing

FABRICATION STUDIES

FAB3010 Materials Testing

WHY TAKE THIS MODULE?

To ensure that your design needs are met, testing is often carried out to determine which materials and processes best meet the desired outcomes. In this module you will:

- investigate methods of determining the properties of various structural materials
- test various materials and processes
- select the most appropriate materials and processes for a given application.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

Prerequisite: CON1010: Basic Tools & Materials

In addition, to be successful in this module you will need to have a basic understanding of material properties and be familiar with fabrication tools, materials and processes.

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

Upon completion of this module you will be able to:

- describe the purpose and nature of materials testing
- apply testing principles to construct or use a piece of materials testing apparatus
- test and compare the properties of common materials used in construction and fabrication
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this module.

You may also wish to use a time-management planning chart to preplan the work that needs to be done in this module. Plan how you will use your class time as well as extra time needed to complete the assignments in this module.

HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	PERCENTAGE
You must first demonstrate **all** of the competencies required for this module. When you have done this, your mark for the module will be determined as follows:	
• Investigation and reporting	20%
• Test proposal	30%
• Lab investigation (Testing Materials, FAB3010–1)	50%

WHICH RESOURCES MAY YOU USE?

- *Metallurgy Testing I & II*, Ball State University.
- *Metalwork – Technology and Practice*, Victor E. Repp, 1994.
- *Welding Technology Fundamentals*, William A. Bowditch et al., 1991.

ACTIVITIES/WORKSHEETS

Types of Tests – Activity 1.0

1.1 Investigate and report on the nature of various tests, such as static tests, dynamic tests, impact tests. Questions your report should answer:

- What is a static test?
- How is a static test conducted?
- What are the nature of hazards involved in this type of testing?
- What is a dynamic test?
- How is a dynamic test conducted?
- What are the nature of the hazards involved in this type of testing?
- What is an impact test?
- How is an impact conducted?
- What are the nature of hazards involved in this type of testing?

1.2 Explain the differences between destructive and non-destructive testing.

1.3 Describe common ways to recognize when a material has failed

Mechanical Tests – Activity 2.0

2.1 Using sketches and notes, prepare a presentation that describes one or more of the tests for the following properties:

- acoustical
- electrical
- magnetic
- mechanical
- optical
- thermal.

Test Proposal – Activity 3.0

3.1 Prepare a testing proposal to present to your teacher for approval.

- List the type of property for which you wish to test.
- Decide on the materials to be tested
- Prepare a plan of the testing equipment you will construct/use to complete the test. Be sure to determine the materials, processes and tools required to construct the testing device

- Plan a safe environment in which to conduct the test
- Present your teacher with your proposal for approval.

Testing – Activity 4.0

4.1 Refer to your plans and:

- construct a piece of test equipment
- establish safety controls
- prepare the materials to be tested
- prepare a recording device on which you will collect data and record observation. Record a brief description of each anticipated test result
- conduct tests as planned
- observe testing results and collect data and samples
- compare testing results to anticipated results.

CAREER &
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STUDIES

FABRICATION STUDIES

SAMPLE STUDENT LEARNING GUIDE

FAB3160 Prefabrication Principles

FABRICATION STUDIES

FAB3160 Prefabrication Principles

WHY TAKE THIS MODULE?

It is often more cost-effective to prefabricate a product in a plant and assemble it later on site. By taking this module you will:

- gain skills in assessing and meeting customer needs
- discover the advantages of working with others to solve problems and using prefabrication principles
- experience the satisfaction of creating a complete component or building a complete structure.

WHAT DO YOU NEED TO KNOW BEFORE YOU START?

Prerequisite: FAB2160: Custom Fabrication

In addition, to be successful in this module you should have a basic understanding of fabrication processes and be able to communicate effectively.

WHAT WILL YOU KNOW AND BE ABLE TO DO WHEN YOU FINISH?

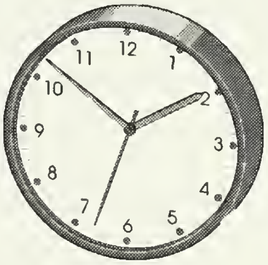
Upon completion of this module you will be able to:

- perform basic shop drawing take-off skills
- demonstrate advanced level resource management skills
- demonstrate appropriate prefabrication skills and practices
- demonstrate basic competencies.

WHEN SHOULD YOUR WORK BE DONE?

Your teacher will give you a timeline for completing tasks and assignments within this module.

You may also wish to use a time-management planning chart to preplan the work that needs to be done in this module. Plan how you will use your class time as well as extra time needed to complete the assignments in this module.



HOW WILL YOUR MARK FOR THIS MODULE BE DETERMINED?

	PERCENTAGE
You must first demonstrate **all** of the competencies required for this module. When you have done this, your mark for the module will be determined as follows:	
• Theory and related activities	20%
• Project planning activities	20%
• Prefabrication project (Prefabricated Product, FAB3160–1)	60%

WHICH RESOURCES MAY YOU USE?

- *Metalwork: Technology and Practice*, Victor E. Repp, 1984.
- *Modern Carpentry*, Willis H. Wagner, et al., 1996.
- *Principles & Practices of Heavy Construction*, Ronald C. Smith, et al., 1993.
- *Technology Shaping our World*, John Gradwell, et al., 1993.

ACTIVITIES/WORKSHEETS

Complete the following activities

Principles of Prefabrication – Activity 1.0

There are numerous reason why it is more economical and time saving to construct a product or structure using prefabrication techniques.

1.1 Make a list of six or more structures in your community that have been built using prefabrication processes, e.g., metal garden shed.

1.2 Examine one of the above examples and determine:
- what processes were carried out in a factory setting
- how were the prefabricated components packaged and delivered to the place where they were assembled
- what instructions were given to the customer/assembler
- what expectations did the customer have of the manufacturer and vice versa.

1.3 Identify the factors that often make it more economical and time efficient to produce a product using prefabrication techniques.

Meeting the Customer's Needs – Activity 2.0

Often the prefabricator is not involved with the final assembly of the product or structure.

2.1 What are some of the questions a prefabricator must have answered prior to making a design proposal?

2.2 Using a real or fictional product or structure identify:
- the components that can be prefabricated
- the work that is to be done on site
- the advantage to both the customer
- and manufacture to build a product/structure in the manner outlined.

Prefabrication Project Proposal – Activity 3.0

3.1 In keeping with a customer's/client's real needs individually or in a group prepare the following;
- overall statement of need, i.e., what is to be built, its purpose, design expectation and limitations
- a design drawing and specification
- materials list and cost
- list of components to prefabricated.

3.2 Prepare a list and provide designs for the needed jigs and fixtures.

3.3 Create a production flow chart, assembly drawing and written instructions

3.4 Identify what method/s the customer is expected to use in the completion phase of the construction, the expertise that will be needed and any additional materials or costs he or she will incur.

Prefabrication Project – Activity 4.0

Construct a product or structure that is best built using prefabrication principles.

4.1 Complete a task analysis and allocate your resources accordingly. If you are working with a team, pay attention to the strengths of each individual and divide the responsibilities to achieve the maximum results. Be sure to consult with your client as you work through the project. Each member of the group is expected to participate in the evaluation of each other's contribution to the project by completing the appropriate form. Each member will also be asked to evaluate the success of the product in meeting the design specifications.

Student:____________________

Date:____________________

Period:____________________

Project:____________________

GROUP EVALUATION FORM

The purpose of this form is to allow you to participate in the evaluation of how well the group functioned as a team in the planning and construction activities. Please select a numerical value, and indicate your rating in the response area provided.

Participation:

All(4), Most(3), Few(2), of your group members participated in the group activities related to the planning of your product. ____________

All(4), Most(3), Few(2), of your group members participated in the group activities related to the construction of your product. ____________

All(4), Most(3), Few(2), of your group members participated in the individually assigned activities related to the construction of your product. ____________

Individual responsibilities:

All(4), Most(3), Few(2), selected their own individual responsibilities the completion of which the group depended. ____________

All(4), Most(3), Few(2), were delegated duties by the group, to be completed. ____________

All(4), Most(3), Few(2), completed their jobs accurately and on time. ____________

All(4), Most(3), Few(2), attended class and participated in the production. ____________

All(4), Most(3), Few(2), individuals cooperated with the other members of the group. _________

All(4), Most(3), Few(2), worked safely and with consideration for others. ____________

Respond with a short written opinion:

What did you enjoy about working within a group?

What did you enjoy the least about working on a group project?

What will you do differently the next time you are involved in a group activity?

K. ACKNOWLEDGEMENTS

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